



Final Work Plan for Contamination Delineation at Remedial Unit C5

**Hunters Point Shipyard
San Francisco, California**

**November 2005
Revision 0**



**DEPARTMENT OF THE NAVY
Base Realignment and Closure
Program Management Office West
1455 Franzee Road, Suite 900
San Diego, California 92109**

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Contract N68711-05-C-6406

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Prepared for:



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Base Realignment and Closure
Program Management Office West
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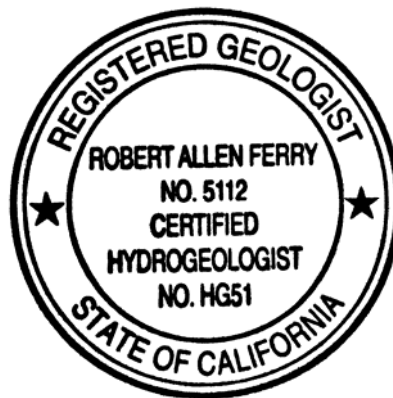
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A handwritten signature in black ink, appearing to read "Robert Ferry".

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- Appendix B. Site-Specific Safety and Health Plan.
- Appendix C. Investigation-Derived Waste Management Plan.
- Appendix D. Responses to Regulatory Comments on the Draft Work Plan.

Abbreviations and Acronyms

ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
BMP	Best Management Practice
BRAC	Base Realignment and Closure
CE2	CE2 Corporation
Kleinfelder	Kleinfelder, Inc.
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
DCA	Dichloroethane
DCB	Dichlorobenzene
DCE	Dichloroethene
DNAPL	Dense Non-Aqueous Phase Liquid
DPT	Direct Push Technology
DTSC	California Department of Toxic Substances Control
EPA	United States Environmental Protection Agency
ft	feet
HPS	Hunters Point Shipyard
IDW	Investigation-Derived Waste
IR	Installation Restoration (Program)
NFECSSW	Naval Facilities Engineering Command - Southwest Division
NPL	National Priorities List
PCE	Tetrachloroethene
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
RU	Remedial Unit
RWQCB	California Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SSHO	Site Safety and Health Officer
SSHP	Site-specific Safety and Health Plan
SVE	Soil Vapor Extraction
TCA	Trichloroethane
TCE	Trichloroethene
TPH	Total Petroleum Hydrocarbons
TtEMI	Tetra Tech EM, Inc.
USCS	Unified Soil Classification System
U.S. Navy	United States Department of the Navy
VOC	Volatile Organic Compound

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1.0 Introduction

1.1 Objectives and Scope of Work

CE2 Corporation (CE2) has prepared this Work Plan for the delineation of subsurface contamination at Remedial Unit C5 (RU-C5) in Parcel C of Hunters Point Shipyard (HPS) in San Francisco, California. This work will be performed for the Installation Restoration (IR) Program of the U.S. Department of the Navy (U.S. Navy), Naval Facilities Engineering Command - Southwest Division (NFECSW) in accordance with Contract N68711-05-C-6406. The investigation will be conducted by CE2 with portions of the work subcontracted to Kleinfelder, Inc. (Kleinfelder), analytical laboratories, a data validation specialist, field sampling support contractors, and an investigation-derived waste (IDW) contractor.

Previous U.S. Navy investigations in the RU-C5 area have indicated that soil and groundwater are contaminated with volatile organic compounds (VOCs) (Tetra Tech EM, Inc. [TtEMI], 2003). RU-C5 is located adjacent to and within Building 134 in Parcel C. The two primary sources of VOCs at RU-C5 are: (1) the sump and dip tank in Building 134 (IR-25), and (2) the former fuel tank farm area (IR-06). The U.S. Navy has identified the need for additional site characterization data at RU-C5 to delineate the lateral and vertical extent of VOC contamination along the boundary between Parcels B and C. This will require collecting and analyzing groundwater samples to supplement the data obtained from previous investigations.

The objectives of this investigation are to:

1. Assess the lateral extent of dissolved-phase VOCs in shallow groundwater (the A-aquifer) along the boundary between Parcels B and C near RU-C5.
2. If dissolved-phase VOCs from RU-C5 have migrated across the boundary into Parcel B, delineate the resulting lateral extent in shallow groundwater in Parcel B.
3. Evaluate the lateral extent of VOCs as Dense Non-Aqueous Phase Liquids (DNAPLs), if present, by collecting and analyzing groundwater samples at the interface between the unconsolidated sediments and bedrock.

The scope of work for this investigation is:

1. Review previously collected site data.
2. Review the results of passive soil gas data collected by CE2 in August-September 2005.
3. Perform soil coring to characterize the hydrostratigraphy in areas where no lithologic data are available, and use these data to optimize subsequent Hydropunch[®] groundwater sampling.
4. Collect Hydropunch[®] groundwater samples from the shallow aquifer and at the interface between the unconsolidated sediments and bedrock.

5. Collect groundwater samples from five existing monitoring wells in the RU-C5 area that are not currently sampled as part of the Basewide Groundwater Monitoring Program.
6. Present the results of the investigation in a Technical Memorandum.

1.2 Project Schedule

A Gantt Chart showing the project schedule is presented as Figure A-12 in the SAP.

1.3 Project Organization and Points of Contact

Table A-1 in the SAP shows the project roles and contact information for key U.S. Navy, CE2, Kleinfelder, and regulatory individuals involved in the RU-C5 contamination delineation project. A project organization chart is provided as Figure A-13 in the SAP.

1.4 Work Plan Organization

This Work Plan is organized as follows:

Section 1.0, Introduction – An overview of the project objectives and scope of work, project schedule, project organization and points of contact, and the organization of the Work Plan.

Section 2.0, Site Conditions and Background – A summary of the site background, history, geology, hydrogeology, and nature and extent of contamination.

Section 3.0, Regulatory Framework – The permitting requirements and potential federal and state applicable or relevant and appropriate requirements (ARARs).

Section 4.0, Technical Approach – A description of the planned site investigation activities.

Section 5.0, Reporting – A list of the major components of the Technical Memorandum for this project.

Section 6.0, References – A list of documents cited in this Work Plan.

Appendix A – Sampling and Analysis Plan (SAP) including a Field Sampling Plan and Quality Assurance Project Plan.

Appendix B – Site-Specific Safety and Health Plan (SSHP).

Appendix C – Investigation-Derived Waste (IDW) Management Plan.

Appendix D – Responses to Regulatory Comments on the Draft Work Plan.

Many figures are used for both the Work Plan and the SAP. To avoid duplication and to allow the SAP to be a stand-alone document, all figures referenced in the Work Plan are provided in the SAP.

2.0 Site Conditions and Background

2.1 HPS Facility Background

HPS is located in the southeastern part of San Francisco that extends east into San Francisco Bay. The location of Hunters Point is shown on Figure A-1 in the SAP. The U.S. Navy controls approximately 848 acres in Parcels B, C, D, E, E2, and F (underwater). Former Parcel A (88 acres) was transferred to the City and County of San Francisco in 2004.

Hunters Point was operated as a commercial drydock facility from 1869 until 1939. In 1940, the U.S. Navy obtained ownership of the shipyard for ship building, repair, and maintenance activities. After World War II, activities shifted from ship repair to submarine servicing and testing. HPS was deactivated in 1974 and remained relatively unused until 1976. Between 1976 and 1986, the U.S. Navy leased most of the property to a privately owned ship repair firm. In 1986, the U.S. Navy again occupied the shipyard and began a program to investigate and clean up contamination resulting from past activities.

In 1989, the U.S. Environmental Protection Agency (EPA) placed HPS on the National Priorities List (NPL). Shipyard activities generated a variety of inorganic, organic, and radioactive wastes. The U.S. Navy IR Program performs remediation at past disposal sites at HPS. HPS was identified for closure during the Base Realignment and Closure (BRAC) process in 1991.

2.2 Physical Setting of Remedial Unit C5

RU-C5 is located near Building 134 in the northern portion of Parcel C and includes IR-25 and IR-06. Building 134 (IR-25) is a two-story building formerly used for shop services and storage. The top floor consists primarily of offices. A large, concrete dip tank labeled “chlorinated materials” was built into the foundation and drained to a below-grade sump that is partly inside and partly outside the building.

From 1940 to 1974, Building 134 was used by the Navy as a machine shop. Activities conducted in the building included parts cleaning and use as the Quality and Reliability Assurance industrial laboratory. Since Base closure in 1974, the building had been leased by Cal Marine Works Machine Shop and used as a warehouse. In 1985, the building was also leased to Odaco, Inc., a refrigeration company. Currently, the building is not being used. Although unoccupied, the building is preserved for potential future uses.

Southwest of Building 134 is a former fuel tank farm (IR-06). The aboveground storage tanks and pumphouse buildings were removed in 1993. Subsequent excavations removed fuel lines and contaminated soil.

2.3 Description of Remedial Unit C5

The following sections present a summary of site use, previous remedial actions, stratigraphy, hydrostratigraphy, groundwater flow direction and velocity, nature and extent of

contamination, and conceptual site models for the RU-C5 area. Primary information sources used to compile this summary include:

- *Draft Final Parcel B Remedial Investigation* (PRC, 1996),
- *Draft Final Parcel C Remedial Investigation* (PRC, 1997),
- *Draft Final Parcel C Feasibility Study* (TtEMI, 1998),
- *Phase II Soil Vapor Extraction Treatability Study Report* (IT Corporation, 2001),
- *Final Parcel C Groundwater Summary Report and Phase III Groundwater Data Gaps Investigation* (TtEMI, 2003),
- *Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan), Basewide Groundwater Monitoring Program* (TtEMI, 2004), and
- *Draft In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study, Remedial Unit RU-C5* (Shaw Environmental, 2005).

2.3.1 Site Use

In the past, Building 134 was used for offices, machine shops, repair shops, a laboratory, and storage. The two primary sources of contamination at RU-C5 are: (1) the degreaser sump and dip tank in Building 134 (IR-25), and (2) the former fuel tank farm area (IR-06).

2.3.2 Previous Remedial Actions

2.3.2.1 Soil Vapor Extraction Treatability Study

A soil vapor extraction (SVE) system was installed and operated for nearly five months inside Building 134 (IT, 2001). Seventeen SVE wells and 46 vapor monitoring wells were installed in January 2001 and operated from February to June 2001. SVE wells were located in the degreaser pit and sump area in the northern portion of Building 134, as well as in the central area of the building, and were screened from 2 to 10 feet (ft) below ground surface (bgs). Both soil gas and soil sampling results indicated that tetrachloroethene (PCE), trichloroethene (TCE), dichloroethene (DCE), and Total Petroleum Hydrocarbons (TPH) as gasoline were present. The cumulative VOC mass removed within the test performance period was estimated at 5 pounds, with mass removal rates between 0.002 and 0.005 pounds per hour. Nearly half of the extracted vapors were comprised of Freon-11 (trichlorofluoromethane), and the remainder was primarily comprised of PCE, TCE, toluene, and xylenes.

2.3.2.2 Anaerobic-Aerobic Bioremediation Treatability Study

In 2004-2005, a sequential anaerobic-aerobic *in situ* bioremediation (ISB) treatability study was conducted at Building 134 (Shaw Environmental, 2005). Prior to conducting the study, the degreaser pit and separator were removed from the site. In addition, affected soil in the degreaser pit area were excavated to the top of the water table, a depth of approximately 7 ft bgs. Soil in the separator area was excavated to a depth of approximately 18 ft bgs. The degreaser pit

excavations was backfilled with clean fill soil and finished with 8 inches of concrete. The separator area excavation was backfilled with gravel (Shaw Environmental, 2004).

The treatability study was conducted in two Stages: (1) anaerobic ISB, and (2) aerobic ISB. The purpose of Stage 1 was to evaluate the biological degradation of chlorinated organics including the chlorinated ethenes, ethanes, and benzenes under anaerobic conditions. The purpose of Stage 2 was to evaluate the biodegradation of potentially reduced residual chlorinated organics and nonchlorinated organics under aerobic conditions. Reducing conditions conducive to the biodegradation of the chlorinated organics within the treatability study wells were established during the anaerobic stage. Geochemical changes indicative of transformation to reducing conditions were observed in each treatability study well. Reductive dechlorination of the chlorinated ethenes and chlorinated benzenes occurred once highly reducing conditions were established. Complete degradation of chlorinated ethenes to ethene and ethane was observed in three of the treatability study wells. Reductive dechlorination of 1,2-DCB (dichlorobenzene) and 1,4-DCB to chlorobenzene was observed in each of the monitoring wells.

Introduction of oxygen to the treatability study area successfully facilitated aerobic biodegradation of nonchlorinated organics and residual reduced chlorinated organics. Oxygen delivery was accomplished using iSOC™ technology, or an *in situ* Submerged Oxygen Curtain, which provides high concentrations of gas without sparging the groundwater. iSOC™ units were installed in each of the treatability study area performance monitoring wells. Oxygen was then delivered from gas cylinders at flow rates that would not result in stripping of volatile organic compounds. During the aerobic stage, conditions conducive to the aerobic biodegradation of organics were established in the treatability study wells. Geochemical parameters indicative of aerobic conditions indicated that many of the parameters had returned to their pre-Stage 1 condition. Elevated concentrations of oxygen were established in each of the treatability study performance monitoring wells. Data confirmed that the addition of the oxygen stimulated the indigenous microorganisms, thus degrading the remaining chlorobenzene and benzene.

2.3.2.3 Fuel Tank Farm

A fuel tank farm was once located at IR-06 adjacent to and southwest of Building 134. The 16 aboveground storage tanks and two pump house buildings were removed in 1993, as described in PRC (1996). Subsequent excavations of this area and the fuel lines from the former fuel tank farm, not including IR-25, were completed under the Parcel B remedial design. Details of the excavations are described in the *Draft Project Completion Report, Tank Farm Excavations, Hunters Point Shipyard, San Francisco, California* (IT, 1998) and the *Draft Parcel B Construction Summary Report, Hunters Point Shipyard, San Francisco, California* (TtEMI, 2002).

2.3.3 Stratigraphy

Five individual stratigraphic units have been identified in the vicinity of RU-C5, from shallow to deep:

Artificial Fill (Q_{af}) – Fill covers the entire RU-C5 area to a thickness of up to 30 ft. It consists mainly of silty and sandy clay with clayey sand, sand, and sandy gravel deposits. The artificial fill overlies natural sediments or bedrock, depending on the location.

Undifferentiated Upper Sand (Q_{uus}) – This unit is comprised of Holocene-age, poorly graded, discontinuous estuarine and alluvial sand deposits that overlie, but in places interbed, with the underlying Bay Mud. These sands may also directly overlie bedrock. The thickness of the undifferentiated upper sand unit is typically 2 to 3 ft in the RU-C5 area.

Bay Mud (Q_{bm}) – The Bay Mud unit consists of Holocene-age estuarine sediments that are predominantly composed of silt and clay but may include clayey or silty sands. The Bay Mud may underlie artificial fill or the upper sand deposits and overlie the deeper undifferentiated sediments or bedrock. Where present, this unit is interbedded with the undifferentiated upper sand unit. The thickness of the Bay Mud unit in the RU-C5 area is typically about 5 ft.

Undifferentiated Sediments (Q_u) – This unit consists of unconsolidated silty or clayey sands containing discontinuous, isolated sand lenses. These sediments can underlie any of the younger units. The thickness of this unit in the RU-C5 area is 5-10 ft.

Bedrock (K_f) – The bedrock consists primarily of serpentinite or metamorphosed basalt and outcrops near Building 108 in Parcel A. The bedrock surface slopes towards the Bay reaching a depth of approximately 40 ft near the northeastern boundary of RU-C5.

Figure A-2 shows hydrogeologic cross-section locations, and the two cross-sections are presented as Figures A-3 and A-4. These cross-sections were originally included in the *Parcel C Groundwater Summary Report and Phase III Groundwater Data Gaps Investigation* (TtEMI, 2003) and have been updated to include lithologic information from the *Draft In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study* (Shaw Environmental, 2005).

2.3.4 Hydrostratigraphy

The aquifer system in the vicinity of RU-C5 consists of an A-aquifer and a bedrock water-bearing zone. The A-aquifer is divided into an upper low-permeability zone and a lower zone.

The upper A-aquifer consists of extremely heterogeneous artificial fill, composed mainly of silty and sandy clay with clayey sand, sand, and sandy gravel deposits. It is continuous across the RU-C5 area. The maximum saturated thickness is about 25 ft. The upper A-aquifer overlies either native sediment or bedrock, depending on location. Groundwater is under unconfined conditions in most areas.

Where present, the Bay Mud stratigraphic unit separates the upper and lower A-aquifers. However, where absent, there is hydraulic communication and potential vertical migration of contaminants between the aquifers.

The lower A-aquifer consists of native sediments and shallow weathered or fractured bedrock. It is continuous over most of the RU-C5 area, but is absent in some places in IR-06. The maximum saturated thickness is about 15 ft. The lower A-aquifer is semiconfined where the upper A-aquifer is comprised of low-permeability materials, elsewhere it is under unconfined conditions.

2.3.5 Groundwater Flow

A potentiometric surface map for the A-aquifer (combined upper and lower A-aquifers) using data from November 2004 is presented as Figure A-5. Groundwater flow is generally northeast toward San Francisco Bay. Steep groundwater gradients are located between Buildings 108 and 134 in a vegetated area surrounding the former fuel tank farm (IR-06). This vegetated area is located on the northeast side of the topographic high in Parcel A. An abrupt flattening of the groundwater gradient near the southwest side of Building 134 coincides with the 1935 shoreline, indicating that the artificial fill and sediments are less permeable than the serpentinite bedrock. The nearly horizontal potentiometric surface near Building 134 indicates suggests that groundwater flow velocity is very low in this area. Depressions in the groundwater contours possibly reflected previous remedial activities near the former dip tank and sump. Vertical gradients between the upper and lower A-aquifers are highly variable, likely as a result of heterogeneity.

Tidal influence of up to 0.2 ft has been observed in wells completed in the shallow bedrock where groundwater is semiconfined. No significant tidal effects have been observed in the unconfined upper A-aquifer.

The representative coefficient of hydraulic conductivity near the sump and dip tanks is estimated to be approximately 0.1 ft/day, and the aquifer storativity is about 0.003. Groundwater flow velocity in the A-aquifer near the main contaminant source area (the sump and dip tank in Building 134) is estimated to be approximately 0.007 ft/day, based on parameters from hydraulic testing.

Slug tests show that hydraulic conductivities for the upper A-aquifer range from 2.8 to 95 ft/day; hydraulic conductivities for the lower A-aquifer range from 0.24 to 0.55 ft/day. Hydraulic conductivity values estimated from constant-rate pump tests at IR-06 ranged from 0.81 to 4.2 ft/day in the upper A-aquifer and 0.36 to 1.06 ft/day in the bedrock. The hydraulic conductivity value estimated from a constant-rate pump test in the lower A-aquifer at the sump and dip tank area (IR-25) was approximately 0.1 ft/day; the estimated storativity was 0.003.

2.3.6 Conceptual Site Model for Hydrogeology

The Conceptual Site Model for hydrogeology at RU-C5 is as follows:

- Most recharge occurs by precipitation falling in unpaved areas located near the former fuel tank farm area in Parcel C and the topographic high in Parcel A located southwest of RU-C5. The annual rainfall is approximately 20 inches.
- Asphalt pavement covers most of the RU-C5 area. Notable exceptions are the grassy area surrounding the former fuel tank farm, scattered gravel areas where remedial excavations have been backfilled, and concrete building foundations. Most of the RU-C5 area is relatively flat with ground elevations that range from approximately 10 to 12 ft above mean sea level.
- Serpentine bedrock outcrops on the southwest side of the former fuel tank farm area. Overburden sediments and artificial fill above the bedrock thicken northeastward reaching a maximum thickness of approximately 40 ft near the northeastern boundary of RU-C5.
- The stratigraphy at RU-C5 is composed of five interbedded units: (1) Artificial Fill, (2) Undifferentiated Upper Sand, (3) Bay Mud, (4) Undifferentiated Sediments, and (5) bedrock.
- At RU-C5, groundwater is present in two hydrostratigraphic units: the A-aquifer and the bedrock water-bearing zone. The A-aquifer consists of an upper A-aquifer composed of artificial fill and a lower A-aquifer consisting of natural sediments. The bedrock water-bearing zone consists of fractured serpentine and metamorphosed basalt (greenstone).
- Near the sump and dip tank at IR-25, the depth to groundwater averages approximately 10 ft bgs.
- Groundwater levels across the RU-C5 area are typically highest in the first quarter of each calendar year, apparently in response to winter rains. Since March 2003, the annual fluctuation of groundwater levels in A-aquifer monitoring wells has ranged from 1 to 4 ft. Bedrock wells had greater fluctuations ranging from 1 to 17 ft.
- The upper and lower A-aquifers are locally hydraulically connected. No continuous aquitard exists across the area.
- The A-aquifer is unconfined across much of the area. However, localized low permeability zones create anomalous water levels (semiconfined to confined conditions) at some monitoring wells. Groundwater flow is generally northeast toward San Francisco Bay
- Natural and anthropogenic heterogeneities have historically created preferential groundwater pathways. The natural heterogeneities consist of stratigraphic discontinuities and bedrock fractures. The anthropogenic heterogeneities consist of scattered pockets of artificial fill and an extensive system of inactive submerged utilities such as storm-sewer lines.

- Quantifying groundwater flow velocities is compounded by the presence of the natural and anthropogenic heterogeneities. Groundwater flow velocities in sediments and bedrock are estimated to be low. The groundwater flow velocity for the A-aquifer near the sump and dip tank (IR-25) was calculated to be 0.007 ft/day. The migration rate of groundwater along some of the submerged utilities is probably higher.
- Tidal effects upon groundwater levels range up to 0.2 ft and are variable due to stratigraphic variations. Wells screened in the shallow bedrock and lower A-aquifer are tidally influenced while wells screened in the upper A-aquifer are not affected by tidal fluctuations.
- The groundwater quality varies from brackish to saline. In November 2004, the maximum concentration of total dissolved solids was 10,280 mg/L.

2.3.7 Nature and Extent of Contamination

Previous investigations identified two principal sources of groundwater contamination: the sump and dip tank in Building 134 (IR-25), and the former fuel tank farm area (IR-06). Activities at these two source areas released VOCs into the subsurface, and VOCs have migrated to groundwater. The former fuel lines running beneath Building 134 and along the northwestern edge of the building also may have released contaminants into soil. Polychlorinated biphenyls, pesticides, semivolatile organic compounds, polynuclear aromatic hydrocarbons, diesel, and metals have been detected at scattered locations and with limited extent, but these contaminants are not within the scope of the site characterization activities described in this Work Plan. There is no identified radionuclide contamination in the RU-C5 area (U.S. Navy, 2004).

2.3.7.1 Groundwater

For this Work Plan, groundwater analytical results for the Quarter 20 sampling effort (October-December 2004) were reviewed for monitoring wells located in Parcels B and C in the RU-C5 area. The distribution of selected VOCs in groundwater is shown on Figure A-6 in the SAP.

The VOCs and maximum concentrations detected in November 2004 were:

- Benzene (maximum 2.6 µg/L),
- Carbon tetrachloride (maximum 4.2 µg/L),
- Chlorobenzene (maximum 1.8 µg/L),
- Chloroform (maximum 2.5 µg/L),
- Dichlorodifluoromethane (maximum 1.8 µg/L),
- 1,1-Dichloroethane (DCA) (maximum 2.9 µg/L), and
- 1,2-DCA (maximum 5.0 µg/L),
- 1,1- DCE (maximum 2.2 µg/L),

- cis-1,2-DCE (maximum 100 µg/L),
- trans-1,2-DCE (maximum 13 µg/L),
- 1,2-DCB (maximum 4.6 µg/L),
- 1,4-DCB (maximum 1.3 µg/L),
- Freon-11 (trichlorofluoromethane) (maximum 590 µg/L).
- Freon 113 (1,1,2-trichlorotrifluoroethane (maximum 32 µg/L),
- PCE (maximum 3.8 µg/L),
- Toluene (maximum 0.35 µg/L),
- 1,1,1-Trichloroethane (TCA) (maximum 0.14 µg/L).
- TCE (maximum 120 µg/L), and
- Vinyl chloride (maximum 39 µg/L).

VOC analytes historically reported in the RU-C5 area, but not detected in November 2004 include:

- Acetone,
- Carbon disulfide,
- Chloroform,
- Ethylbenzene,
- Naphthalene,
- 1,2,3-Trichlorobenzene,
- 1,2,4-Trichlorobenzene, and
- Xylenes.

2.3.7.2 Soil Gas Survey

To support the investigation described in this Work Plan, a screening-level passive soil gas survey was conducted by CE2 in the RU-C5 area in August-September of 2005. The EMFLUX[®] passive soil gas method was used to assess the horizontal extent of VOCs in the subsurface along and adjacent to the boundary between Parcels B and C. The survey followed the protocols described in EPA Report EPA/600/R-98/096 (EPA, 1998). EMFLUX[®] has been used successfully by the U.S. Navy at other sites, including the Portsmouth Naval Shipyard and the Charleston Naval Weapons Station.

Each EMFLUX[®] sampler consisted of two hydrophobic adsorbent cartridges in a 40 milliliter (ml) vial with a gas-permeable septum. To install each sampler, a 1-2 inch diameter hole was made to a minimum depth of 11 inches using Direct-Push Technology (DPT). If permeable subbase was encountered beneath pavement, the hole was deepened until less permeable material is reached. A 0.75-inch diameter precleaned metal pipe with a minimum length of 12 inches was

placed in the hole and driven 1 inch into the soil at the bottom of the hole. The purpose of the pipe was to isolate the sampling cartridge from vapor that may have accumulated in permeable subbase beneath pavement. The length of the pipe depended on the depth of the drilled hole (i.e., the pipe was 1 inch longer than the hole was deep). The sampler containing the adsorbent cartridges was suspended within the pipe, and the top of the pipe was covered with an aluminum foil plug and a thin concrete patch to protect the sampler. The samplers were exposed to subsurface soil gas for about 7 days. Following the exposure period, the samplers were retrieved and shipped to the laboratory for analysis. The samples were analyzed for VOCs using EPA Method 8260B.

The survey was conducted in two Phases (A and B). Phase A (August 2005) consisted of 26 passive soil gas samples. Phase B (September 2005) consisted of 25 additional samples to provide more detailed information in some areas. Isoconcentration maps for selected analytes are presented as Figures A-7 through A-11 in the SAP. The data generally indicate higher levels of soil gas contamination in the area north of Building 134.

A full report of the passive soil gas survey will be presented in the Technical Memorandum for this project.

2.3.8 Conceptual Site Models for Contamination

Principal elements of the site conceptual model specific to the sump and dip tank area (IR-25) are:

- A variety of VOCs were released at the IR-25 source area, including PCE, TCE, 1,2-DCB, 1,4-DCB, and Freon compounds. Degradation of these VOCs is indicated by the presence of breakdown products.
- VOC contamination has migrated vertically from the sump and dip tank to both the upper and lower A-aquifer. VOCs as DNAPLs were identified in previous investigations. Dissolved phase transport also has occurred.
- Where present, the Bay Mud hydrostratigraphic unit separates the upper and lower A-aquifers. However, this unit is not continuous across RU-C5 and gaps in the Bay Mud may have allowed DNAPLs to migrate downward to the bedrock surface. An objective of the investigation described in this Work Plan is to determine if DNAPLs are present, and if so, have they migrated laterally across the Parcel B/C boundary.
- The lateral extent of VOC contamination in the A-aquifer has been partially delineated, but there is a lack of data along the Parcel B/C boundary, particularly between Buildings 130 and 134.
- A combination of natural heterogeneities (stratigraphic discontinuities and bedrock fractures) and anthropogenic heterogeneities (scattered pockets of artificial fill and an extensive system of submerged utilities) has historically created preferential groundwater pathways.
- The results of the passive soil gas survey suggest that VOCs have migrated across the Parcel B/C boundary, particularly in the area between Buildings 134 and 130. These

data will help guide the Hydropunch[®] groundwater sampling described in this Work Plan.

Principal elements of the site conceptual model for the fuel tank farm area (IR-06) are:

- The principal contaminants released at the IR-06 source area are the chlorinated solvents PCE and TCE. PCE and TCE have degraded to 1,2-DCA, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride. Vinyl chloride and cis-1,2-DCE are present at concentrations higher than PCE and TCE, indicating that degradation has occurred to a greater degree than at the sump and dip tanks.
- There is no evidence of VOCs as DNAPLs in the IR-06 area.
- Dissolved phase contamination has migrated downward to the upper A-aquifer, which directly overlies bedrock.
- A combination of natural heterogeneities (stratigraphic discontinuities and bedrock fractures) and anthropogenic heterogeneities (scattered pockets of artificial fill and an extensive system of submerged utilities) has historically created preferential groundwater pathways.
- The lateral extent of VOC contamination in the A-aquifer has been partially delineated, but there is a lack of data along the Parcel B/C boundary.
- The results of the passive soil gas survey suggest that VOCs may have migrated across the Parcel B/C boundary in the area west of the former fuel tank farm. These data will help guide the Hydropunch[®] groundwater sampling described in this Work Plan.

3.0 Regulatory Framework

Under Executive Order 12580, the U.S. Navy is the lead agency responsible for the cleanup effort. The U.S. EPA, the California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB) provide regulatory oversight.

The site investigation activities at RU-C5 will be conducted under the IR Program. Activities are performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan.

3.1 Permitting Requirements

In accordance with Section 121(e) of CERCLA 1980 [CERCLA, 42 United States Code, Section 9621(e)], as amended, which states that no federal, state, or local permits shall be required for the portion of any removal or remedial action conducted entirely onsite, the work activities to be conducted do not require permits. Although formal permits are not required, substantive compliance with applicable requirements will be met.

3.2 Potential Applicable or Relevant and Appropriate Requirements

This section provides a brief description of the environmental regulatory requirements that are potentially ARARs for the RU-C5 site investigation.

3.2.1 Coastal Resource

The Coastal Zone Management Act (16 USC, Sections 1451 through 1464) specifically excludes federal lands from the coastal zone [16 USC, Section 1451(1)]. The San Francisco Bay Development Commission is the federally designated state coastal management agency for the San Francisco Bay and has jurisdiction in the greater San Francisco Bay area. The Development Commission is authorized under state law and the Coastal Zone Management Act to review federal projects to determine federal consistency but the U.S. Navy is not required to obtain project approval. The Coastal Zone Management Act is not an ARAR for HPS.

3.2.2 California Coastal Act of 1976

The California Coastal Act is codified in California Public Resources Code, Sections 30000 through 30900, and Title 14 California Code of Regulations (CCR), Sections 13001 through 13666.4. These sections regulate activities associated with development to control direct significant impacts on coastal waters and to protect state and national interests in California coastal resources. The work area is located proximate to San Francisco Bay and is in a coastal area. However, since federal lands are specifically excluded from the definition of coastal zone, the California Coastal Act is not an ARAR for the RU-C5 investigation.

3.2.3 Wetlands Protection and Floodplains Management

Work activities will take place outside of the intertidal zone. RU-C5 is not located within a floodplain. Therefore, Executive Order No. 11990, Protection of Wetlands [40 Code of Federal Regulations (CFR), Part 6.302(a)], Executive Order No. 11988, Floodplain Management [40 CFR, Part 6.302(b)], and Section 404 of the Clean Water Act (Title 33, USC, Section 1344) are not ARARs for the RU-C5 investigation.

3.2.4 State Stormwater

The investigation activities at RU-C5 are not anticipated to include activities that would impact stormwater. However, a stormwater Best Management Practice (BMP) will be followed to prevent runoff from the site from affecting San Francisco Bay by maintaining good housekeeping practices (i.e., ensuring no contaminated soil or groundwater are left on the pavement that could be transported to the Bay by runoff).

3.2.5 Federal and State Hazardous Waste Storage

The Resource Conservation and Recovery Act (RCRA) (42 USC ch. 82 6901 et seq, 40 CFR 261 through 268) and CCR Title 22 Division 4.5 establishes the requirements for management of hazardous waste. Wastes generated on site will be managed with applicable provisions of these requirements. Specific procedures for IDW management are presented in Appendix C.

CCR Title 22, Section 20200, contains the requirements for solid waste classification and management. Wastes determined to be nonhazardous will be managed in accordance with this ARAR.

3.2.6 State Well Standards and Codes

Site investigation activities will be performed in a manner consistent with California Well Standards, Bulletins 74-81 and 74-90 and the California Water Code, Division 7.

4.0 Technical Approach

The following sections present the technical approach for conducting the contamination delineation activities at RU-C5. Detailed sampling procedures, sample locations, field methods, quality assurance/quality control (QA/QC), and data management information are included in the SAP.

4.1 Preparatory Activities

Activities that will be performed prior to beginning field work will include permitting and notifications, site-specific training, and utility clearance.

4.1.1 Permitting and Notifications

Prior to the field mobilization, the U.S. Navy Remedial Project Manager (RPM), Resident Officer in Charge of Construction (ROICC), and the appropriate HPS security and fire department personnel will be notified regarding the anticipated work. A list of field personnel will be delivered to the City of San Francisco Redevelopment Agency to arrange for authorized entry badges. A list of personally owned vehicles, along with the required insurance and registration documentation, will also be provided.

4.1.2 Training

Safety and health requirements for this project are presented in the SSHP. Prior to the start of field activities, personnel assigned to perform the work will receive project orientation, which includes review of the Site-Specific Safety and Health Plan and Activity Hazard Analyses.

Personnel assigned to the project will be competent and qualified to perform the tasks required by the scope of work by: (1) receiving the appropriate training and instruction, and (2) being familiar with the relevant project procedural documents.

4.1.3 Utility Clearance

Before performing excavation/drilling/coring activity, USA Dig-Alert (1-800-227-2600) will be contacted and as-built plans will be reviewed. A subcontracted utility locator will supplement USA Dig-Alert's demarcations. Subsurface intrusive work will not proceed until locating activities have been completed and documented in the site records. The safety orientation meeting for field personnel will include: (1) reviewing of a map of known or suspected underground utilities, and (2) conducting a site walkover to familiarize personnel with the locations of known or suspected utilities.

For drilling in areas where the presence of underground utilities is known or suspected, a hand auger will be advanced a minimum of 5 ft bgs prior to powered drilling operations. Any locations or areas where hand augering is not required will be approved by the U.S. Navy.

4.2 Mobilization

Mobilization activities will include site preparation, movement of equipment and materials to the site, and orientation of field personnel. Upon receipt of appropriate and authorizations, field personnel and required equipment and materials will be mobilized to the site.

4.3 Sampling Design

The site investigation will be performed using a strategy designed to accomplish the following project objectives:

1. Assess the lateral extent of dissolved-phase VOCs in shallow groundwater (the A-aquifer) along the boundary between Parcels B and C near RU-C5.
2. If dissolved-phase VOCs from RU-C5 have migrated across the boundary into Parcel B, delineate the resulting lateral extent in shallow groundwater in Parcel B.
3. Evaluate the lateral extent of VOCs as DNAPLs, if present, by collecting and analyzing groundwater samples at the interface between the unconsolidated sediments and bedrock.

The general approach to achieving these objectives is:

1. Initially, collect lithologic and groundwater VOC concentration data along the Parcel B/C boundary.
2. Review these data and collect additional data on both sides of the Parcel B/C boundary.
3. Collect groundwater samples from five existing monitoring wells in the RU-C5 area that are not currently part of the Basewide Groundwater Monitoring Program.

Detailed sampling procedures, sample locations, field methods, QA/QC, and data management information are included in the SAP.

4.4 Decontamination

All nondisposable field equipment will be thoroughly cleaned and decontaminated before and after each use at each sampling location to obtain representative samples and to reduce the possibility of cross-contamination. The following procedure will be used:

1. Wash with nonphosphate detergent and water solution (e.g., Alconox[®] or Liqui-Nox[®] solutions made as directed by the manufacturer).
2. Rinse with potable water. Change the water frequently. This step will decrease the gross contamination and reduce the frequency at which the nonphosphate detergent and water solution need to be changed.
3. Rinse twice with deionized water and allow to air-dry.
4. Containerize decontamination water pending characterization and disposal.

4.5 Demobilization

Demobilization will consist of:

1. Decontaminating and removing equipment used to conduct the investigation,
2. Collecting and disposing of contaminated material, decontamination water, disposable equipment, and IDW,
3. Grouting temporary boreholes and repairing the pavement surface at each borehole, and
4. Cleanup.

4.6 Management of Investigation-Derived Waste

The types of IDW generated may include:

1. Soil cuttings from hand auger holes advanced to confirm utility clearance,
2. Soil cores,
3. Wastewater from equipment decontamination,
4. Purge water from Hydropunch[®] and monitoring well sampling,
5. Used personal protective equipment (PPE), and
6. Inert or nonhazardous solid waste (refuse and/or concrete/asphalt cores).

IDW will be disposed of according to the methods and procedures described in the IDW Management Plan (Appendix C).

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5.0 Reporting

The results of the site characterization will be reported in a Technical Memorandum reviewed and signed by a California-licensed Professional Geologist. The Technical Memorandum will include, at a minimum:

- Descriptions of field activities and methodologies used,
- Analytical data,
- Isoconcentration maps,
- Interpretations of the results, and
- Recommendations.

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Contract N68711-05-C-6406

Appendix A:

Final Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) for Contamination Delineation at Remedial Unit C5

**Hunters Point Shipyard
San Francisco, California**

**November 2005
Revision 0**

Prepared for:



Department of the Navy
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**Final Sampling and Analysis Plan
(Field Sampling Plan and Quality Assurance Project Plan) for
Contamination Delineation at Remedial Unit C5**

**November 2005
Revision 0**

**Hunters Point Shipyard
San Francisco, California**

**Contract Number N68711-05-C-6406
Delivery Order 001**


**Prepared for:
U.S. Department of the Navy**

Review and Approval

**CE2 Corporate QA
Officer**

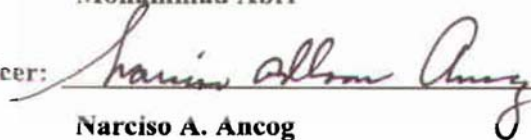


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U.S. Navy QA Officer:



Narciso A. Ancog



Date

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Abbreviations and Acronyms

%R	Percent Recovery
°C	Degrees Celsius
µg/L	Micrograms per Liter
°F	Degrees Fahrenheit
ARAR	Applicable or Relevant and Appropriate Requirement
APPL	Agriculture and Priority Pollutants Laboratory, Inc.
BEACON	BEACON Environmental Services, Inc.
bgs	below ground surface
BRAC	Base Realignment and Closure
CE2	CE2 Corporation
Kleinfelder	Kleinfelder, Inc.
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chain of Custody
DCA	Dichloroethane
DCB	Dichlorobenzene
DCE	Dichloroethene
DNAPL	Dense Non-Aqueous Phase Liquid
DPT	Direct Push Technology
DQA	Data Quality Assessment
DQO	Data Quality Objective
DTSC	California Department of Toxic Substances Control
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
EPA	United States Environmental Protection Agency
ft	feet
GC/MS	Gas Chromatograph/Mass Spectrometer
GIS	Geographic Information System
HPS	Hunters Point Shipyard
IDL	Instrument Detection Limit
IDW	Investigation-Derived Waste
IR	Installation Restoration (Program)
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
MDL	Method Detection Limit
mL	Milliliter
MS	Matrix Spike

Abbreviations and Acronyms (continued)

MSD	Matrix Spike Duplicate
NAVFAC	Naval Facilities Engineering Command, Southwest Division
U.S. Navy	United States Department of the Navy
NEDD	Naval Electronic Data Deliverable
NFESC	Naval Facilities Engineering Service Center
NIRIS	Naval Installation Restoration Information Solution
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCE	Tetrachloroethene
PID	Photoionization Detector
PPE	Personal Protective Equipment
ppmv	Parts per million by volume
PRC	PRC Environmental Management, Inc.
PRQL	Project-Required Quantitation Limit
QA	Quality Assurance
QAO	Quality Assurance Officer
QC	Quality Control
QCSR	Quality Control Summary Report
RAMP	Remedial Action Monitoring Plan
RCRA	Resource Conservation and Recovery Act
RL	Reporting Limit
ROICC	Resident Officer in Charge of Construction
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RU	Remedial Unit
RWQCB	California Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SDG	Sample Delivery Group
SOP	Standard Operating Procedure
SQL	Sample Quantitation Limit
SSHO	Site Safety and Health Officer
TCE	Trichloroethene
TtEMI	Tetra Tech EM, Inc.
USCS	Unified Soil Classification System
VOC	Volatile Organic Compound
WP	Work Plan

Elements of EPA QA-R5 in Relation to this SAP

EPA QA/R-5 QAPP Element ^a	SAP Element
A1 Title and Approval Sheet	Title and Approval Sheet
A2 Table of Contents	Table of Contents
A3 Distribution List	Distribution List
A4 Project/Task Organization	1.4 Project Organization
A5 Problem Definition/Background	1.1 Project Definition and Background
A6 Project/Task Description	1.2 Project Description
A7 Quality Objectives and Criteria	1.3 Quality Objectives and Criteria
A8 Special Training/Certification	1.5 Special Training and Certification
A9 Documents and Records	1.6 Documents and Records
B1 Sample Process Design	2.1 Sampling Process and Design
B2 Sampling Methods	2.1.5 Sampling Methods and Equipment
B3 Sample Handling and Custody	2.2 Sample Handling and Custody
B4 Analytical Methods	2.3 Analytical Methods
B5 Quality Control	2.4 Quality Control
B6 Instrument/Equipment Testing, Inspection, and Maintenance	2.5 Equipment Testing, Inspection, and Maintenance
B7 Instrument/Equipment Calibration and Frequency	2.6 Instrument Calibration and Frequency
B8 Inspection/Acceptance of Supplies and Consumables	2.7 Inspection and Acceptance of Supplies and Consumables
B9 Non-Direct Measurements	2.8 Non-Direct Measurements
B10 Data Management	2.9 Data Management
C1 Assessment and Response Actions	3.1 Assessment and Response Actions
C2 Reports to Management	3.2 Reports to Management
D1 Data Review, Verification, and Validation	4.1 Data Review, Verification, and Validation
D2 Verification and Validation Methods	4.1 Data Review, Verification, and Validation
D3 Reconciliation with User Requirements	1.3.1 Data Quality Objectives

Notes:

^a EPA. 2001. *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, QAMS*. March.

EPA – U.S. Environmental Protection Agency.

QA – Quality Assurance

SAP – Sampling and Analysis Plan

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1.0 Project Description and Management

CE2 Corporation (CE2) has prepared this Sampling and Analysis Plan (SAP) for the delineation of subsurface contamination at Remedial Unit C5 (RU-C5) in Parcel C of Hunters Point Shipyard (HPS) in San Francisco, California. The work will be performed for the Installation Restoration (IR) Program of the U.S. Department of the Navy, Naval Facilities Engineering Command (NAVFAC), Southwest Division in accordance with Contract N68711-05-C-6406. The investigation will be conducted by CE2 with portions of the work subcontracted to Kleinfelder, Inc. (Kleinfelder), analytical laboratories, data validation specialist, field sampling support contractors, and an investigation-derived waste contractor.

Included in this SAP are field sampling procedures, data quality objectives (DQOs), quality assurance/quality control (QA/QC) requirements, data management, schedule, and the organization of this project.

1.1 Project Definition and Background

The following sections present the statement of the problem and the objectives of the project. More detailed background information is provided in the Work Plan.

1.1.1 Statement of the Problem

Previous U.S. Navy investigations in the RU-C5 area have indicated that soil and groundwater are contaminated with volatile organic compounds (VOCs). RU-C5 is located adjacent to and within Building 134 in Parcel C. The two primary sources of VOCs at RU-C5 are: (1) the sump and dip tank in Building 134 (IR-25), and (2) the former fuel tank farm area (IR-06).

1.1.2 Problem to be Solved

The U.S. Navy has identified the need for additional site characterization data at RU-C5 to delineate the lateral and vertical extent of VOC contamination along the boundary between Parcels B and C. This will require collecting and analyzing groundwater samples.

1.1.3 HPS Facility Background

HPS is located in the southeastern part of San Francisco that extends east into San Francisco Bay. The location of Hunters Point is shown on Figure A-1. The U.S. Navy controls approximately 848 acres in Parcels B, C, D, E, E2, and F (underwater). Former Parcel A (88 acres) was transferred to the City and County of San Francisco in 2004.

In 1989, the U.S. Environmental Protection Agency (EPA) placed HPS on the National Priorities List (NPL). Shipyard activities generated a variety of inorganic, organic, and radioactive wastes. The U.S. Navy IR Program performs remediation at past disposal sites at HPS. HPS was identified for closure during the Base Realignment and Closure (BRAC) process in 1991.

1.1.4 Physical Setting of Remedial Unit C5

RU-C5 is located near Building 134 in the northern portion of Parcel C and includes IR-25 and IR-06. Building 134 is a two-story building formerly used for shop services and storage. The top floor consists primarily of offices. A large, concrete dip tank labeled “chlorinated materials” was built into the foundation and drained to a below-grade sump that is partly inside and partly outside the building. Southwest of Building 134 is a former fuel tank farm (IR-06).

1.1.5 Description of Remedial Unit C5

The following sections present brief summaries of site use, stratigraphy, hydrostratigraphy, groundwater flow direction and velocity, the nature and extent of contamination in the RU-C5 area, and site conceptual models. More detailed information on these characteristics of the RU-C5 area is provided in the Work Plan.

Primary information sources used to compile this summary include:

- *Draft Final Parcel B Remedial Investigation* (PRC, 1996),
- *Draft Final Parcel C Remedial Investigation* (PRC, 1997),
- *Draft Final Parcel C Feasibility Study* (TtEMI, 1998),
- *Phase II Soil Vapor Extraction Treatability Study Report* (IT Corporation, 2001),
- *Final Parcel C Groundwater Summary Report and Phase III Groundwater Data Gaps Investigation* (TtEMI, 2003),
- *Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan), Basewide Groundwater Monitoring Program* (TtEMI, 2004), and
- *Draft In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study, Remedial Unit RU-C5* (Shaw Environmental, 2005).

1.1.5.1 Site Use

In the past, Building 134 was used for offices, machine shops, repair shops, a laboratory, and storage. From 1940 to 1974, Building 134 was used by the U.S. Navy as a machine shop. Activities conducted in the building included parts cleaning and use as the Quality and Reliability Assurance industrial laboratory. Since Base closure in 1974, the building had been leased by Cal Marine Works Machine Shop and used as a warehouse. In 1985, the building was also leased to Odaco, Inc., a refrigeration company. Currently, the building is not being used. Although unoccupied, the building is preserved for potential future uses.

The fuel tank farm has been completely decommissioned.

1.1.5.2 Stratigraphy

Five individual stratigraphic units have been identified in the vicinity of RU-C5, from shallow to deep:

- Artificial Fill (Q_{af}),
- Undifferentiated Upper Sand (Q_{uus}),
- Bay Mud (Q_{bm}),
- Undifferentiated Sediments (Q_u), and
- Bedrock (K_f).

Figure A-2 shows hydrogeologic cross-section locations, and the two cross-sections are presented as Figures A-3 and A-4. These cross-sections were originally included in the *Parcel C Groundwater Summary Report and Phase III Groundwater Data Gaps Investigation* (TtEMI, 2003) and have been updated to include lithologic information from the *Draft In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study* (Shaw Environmental, 2005).

1.1.5.3 Hydrostratigraphy

The aquifer system in the vicinity of RU-C5 consists of an A-aquifer and a bedrock water-bearing zone. The A-aquifer is divided into the upper A-aquifer and the lower A-aquifer. Where present, the Bay Mud stratigraphic unit separates the upper and lower A-aquifers. However, where absent, there is hydraulic communication and potential vertical migration of contaminants between the aquifers.

1.1.5.4 Groundwater Flow

A potentiometric surface map for the A-aquifer (combined upper and lower A-aquifers) using data from November 2004 is presented as Figure A-5. Groundwater flow is generally northeast toward San Francisco Bay.

1.1.5.5 Conceptual Site Model for Hydrogeology

The Conceptual Site Model for hydrogeology at RU-C5 is as follows:

- Most recharge occurs by precipitation falling in unpaved areas located near the former fuel tank farm area in Parcel C and the topographic high in Parcel A located southwest of RU-C5. The annual rainfall is approximately 20 inches.
- Asphalt pavement covers most of the RU-C5 area. Notable exceptions are the grassy area surrounding the former fuel tank farm area, scattered gravel areas where remedial excavations have been backfilled, and concrete building foundations. Most of the RU-C5 area is relatively flat with ground elevations that range from approximately 10 to 12 feet (ft) above mean sea level.
- Serpentinite bedrock outcrops on the southwest side of the former fuel tank farm area. Overburden sediments and artificial fill above the bedrock thicken northeastward.

reaching a maximum thickness of approximately 40 ft near the northeastern boundary of RU-C5. The general dip of the bedrock is toward the north.

- The stratigraphy at RU-C5 is composed of five interbedded units: (1) Artificial Fill, (2) Undifferentiated Upper Sand, (3) Bay Mud, (4) Undifferentiated Sediments, and (5) bedrock.
- At RU-C5, groundwater is present in two hydrostratigraphic units: the A-aquifer and the bedrock water-bearing zone. The A-aquifer consists of an upper A-aquifer composed of artificial fill and a lower A-aquifer consisting of natural sediments. The bedrock water-bearing zone consists of fractured serpentinite and metamorphosed basalt (greenstone).
- Near the sump and dip tank at IR-25, the depth to groundwater averages approximately 10 ft bgs.
- Groundwater levels across the RU-C5 area are typically highest in the first quarter of each calendar year, apparently in response to winter rains. Since March 2003, the annual fluctuation of groundwater levels in A-aquifer monitoring wells has ranged from 1 to 4 ft. Bedrock wells had greater fluctuations ranging from 1 to 17 ft.
- The upper and lower A-aquifers are locally hydraulically connected. No continuous aquitard exists across the area.
- The A-aquifer is unconfined across much of the area. However, localized low permeability zones create anomalous water levels (semiconfined to confined conditions) at some wells. Groundwater flow is generally northeast toward San Francisco Bay
- Natural and anthropogenic heterogeneities have historically created preferential groundwater pathways. The natural heterogeneities consist of stratigraphic discontinuities and bedrock fractures. The anthropogenic heterogeneities consist of scattered pockets of artificial fill and an extensive system of inactive submerged utilities such as storm-sewer lines.
- Quantifying groundwater flow velocities is compounded by the presence of the natural and anthropogenic heterogeneities. Groundwater flow velocities in sediments and bedrock are estimated to be low. The groundwater flow velocity for the A-aquifer near the sump and dip tank (IR-25) was calculated to be 0.007 ft/day. The migration rate of groundwater along some of the submerged utilities is probably higher.
- Tidal effects upon groundwater levels range up to 0.2 ft across the RU-C5 area and are variable due to stratigraphic variations. Wells screened in the shallow bedrock and lower A-aquifer are tidally influenced while wells screened in the upper A-aquifer are not affected by tidal fluctuations.

1.1.5.6 Nature and Extent of Contamination

Previous investigations identified two principal sources of groundwater contamination: the sump and dip tank in Building 134 (IR-25), and the former fuel tank farm area (IR-06). Activities at these two source areas released VOCs into the subsurface, and VOCs have migrated to groundwater. The former fuel lines running beneath Building 134 and along the northwestern edge of the building also may have released contaminants into soil. Polychlorinated biphenyls, pesticides, semivolatile organic compounds, polynuclear aromatic hydrocarbons, diesel, and metals have been detected at scattered locations and with limited extent, but these contaminants are not within the scope of the site characterization activities described in this SAP. There is no identified radionuclide contamination in the RU-C5 area (U.S. Navy, 2004).

The VOCs and maximum concentrations detected in groundwater samples collected October-December 2004 were:

- Benzene (maximum 2.6 µg/L),
- Carbon tetrachloride (maximum 4.2 µg/L),
- Chlorobenzene (maximum 1.8 µg/L),
- Chloroform (maximum 2.5 µg/L),
- Dichlorodifluoromethane (maximum 1.8 µg/L),
- 1,1-Dichloroethane (DCA) (maximum 2.9 µg/L), and
- 1,2-DCA (maximum 5.0 µg/L),
- 1,1- Dichloroethene (DCE) (maximum 2.2 µg/L),
- cis-1,2-DCE (maximum 100 µg/L),
- trans-1,2-DCE (maximum 13 µg/L),
- 1,2-Dichlorobenzene (DCB) (maximum 4.6 µg/L),
- 1,4-DCB (maximum 1.3 µg/L),
- Freon-11 (trichlorofluoromethane) (maximum 590 µg/L).
- Freon 113 (1,1,2-trichlorotrifluoroethane (maximum 32 µg/L),
- Tetrachloroethene (PCE) (maximum 3.8 µg/L),
- Toluene (maximum 0.35 µg/L),
- 1,1,1-Trichloroethane (TCA) (maximum 0.14 µg/L).
- Trichloroethene (TCE) (maximum 120 µg/L), and
- Vinyl chloride (maximum 39 µg/L).

VOC analytes historically reported in the RU-C5 area, but not detected in groundwater in October-December 2004 include:

- Acetone,
- Carbon disulfide,
- Chloroform,
- Ethylbenzene,
- Naphthalene,
- 1,2,3-Trichlorobenzene,
- 1,2,4-Trichlorobenzene, and
- Xylenes.

The distribution of selected VOCs in groundwater in October-December 2004 is shown on Figure A-6.

To support the investigation described in this SAP, a screening-level passive soil gas survey was conducted by CE2 in the RU-C5 area in August-September of 2005. The EMFLUX[®] passive soil gas method was used to assess the horizontal extent of VOCs in the subsurface along and adjacent to the boundary between Parcels B and C. The survey was conducted in two Phases (A and B). Phase A (August 2005) consisted of 26 passive soil gas samples. Phase B (September 2005) consisted of 25 additional samples to provide more detailed information in some areas. Isoconcentration maps for selected analytes are presented as Figures A-7 through A-11. The data generally indicate higher levels of soil gas contamination in the area north of Building 134. More details of this survey are presented in Section 2.3.7.2 of the Work Plan. A full report of this passive soil gas survey will be presented in the Technical Memorandum for this project.

1.1.5.7 Conceptual Site Model for Contamination

Principal elements of the site conceptual model specific to the sump and dip tank area (IR-25) are:

- A variety of VOCs were released at the IR-25 source area, including PCE, TCE, 1,2-DCB, 1,4-DCB, and Freon compounds. Degradation of these VOCs is indicated by the presence of breakdown products.
- VOC contamination has migrated vertically from the sump and dip tank to both the upper and lower A-aquifer. VOCs as Dense Non-Aqueous Phase Liquids (DNAPLs) were identified in previous investigations. Dissolved phase transport also has occurred.
- Where present, the Bay Mud hydrostratigraphic unit separates the upper and lower A-aquifers. However, this unit is not continuous across RU-C5 and gaps in the Bay Mud may have allowed DNAPLs to migrate downward to the bedrock surface. An

objective of the investigation described in this Work Plan is to determine if DNAPLs are present, and if so, have they migrated laterally across the Parcel B/C boundary.

- The lateral extent of VOC contamination in the A-aquifer has been partially delineated, but there is a lack of data along the Parcel B/C boundary, particularly between Buildings 130 and 134.
- A combination of natural heterogeneities (stratigraphic discontinuities and bedrock fractures) and anthropogenic heterogeneities (scattered pockets of artificial fill and an extensive system of submerged utilities) has historically created preferential groundwater pathways.
- The results of the passive soil gas survey suggest that VOCs have migrated across the Parcel B/C boundary, particularly in the area between Buildings 134 and 130. These data will help guide the Hydropunch[®] groundwater sampling described in this SAP.

Principal elements of the site conceptual model for the fuel tank farm area (IR-06) are:

- The principal contaminants released at the IR-06 source area are the chlorinated solvents PCE and TCE. PCE and TCE have degraded to 1,2-DCA, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride. Vinyl chloride and cis-1,2-DCE are present at concentrations higher than PCE and TCE, indicating that degradation has occurred to a greater degree than at the sump and dip tanks.
- There is no evidence of VOCs as DNAPLs in the IR-06 area.
- Dissolved phase contamination has migrated downward to the upper A-aquifer, which directly overlies bedrock.
- A combination of natural heterogeneities (stratigraphic discontinuities and bedrock fractures) and anthropogenic heterogeneities (scattered pockets of artificial fill and an extensive system of submerged utilities) has historically created preferential groundwater pathways.
- The lateral extent of VOC contamination in the A-aquifer has been partially delineated, but there is a lack of data along the Parcel B/C boundary.
- The results of the passive soil gas survey also suggest that VOCs may have migrated across the Parcel B/C boundary in the area west of the former fuel tank farm. These data will help guide the Hydropunch[®] groundwater sampling described in this Work Plan.

1.1.6 Previous Investigations and Remediation

Previous site investigation reports relevant to the contamination delineation at RU-C5 include:

- *Draft Final Parcel B Remedial Investigation* (PRC, 1996),
- *Draft Final Parcel C Remedial Investigation* (PRC, 1997),
- *Draft Final Parcel C Feasibility Study* (TtEMI, 1998),

- *Final Parcel C Groundwater Summary Report and Phase III Groundwater Data Gaps Investigation* (TtEMI, 2003),
- *Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan), Basewide Groundwater Monitoring Program* (TtEMI, 2004), and

In addition, the passive soil gas survey conducted by CE2 in August-September 2005 will support the investigation described in this SAP.

Previous remediation efforts in the RU-C5 area include:

- A soil vapor extraction (SVE) system was installed and operated for nearly five months inside Building 134 (IT, 2001). Seventeen SVE wells and 46 vapor monitoring wells were installed in January 2001 and operated from February to June 2001. The cumulative VOC mass removed within the test performance period was estimated at 5 pounds, with mass removal rates between 0.002 and 0.005 pounds per hour. Nearly half of the extracted vapors were comprised of Freon-11 (trichlorofluoromethane), and the remainder was primarily comprised of PCE, TCE, toluene, and xylenes. These activities are documented in the Phase II Soil Vapor Extraction Treatability Study Report (IT Corporation, 2001).
- In 2004-2005, a sequential anaerobic-aerobic *in situ* bioremediation (ISB) treatability study was conducted at Building 134 (Shaw Environmental, 2005). Prior to conducting the study, the degreaser pit and separator were removed from the site. In addition, affected soil in the degreaser pit area were excavated to the top of the water table, a depth of approximately 7 ft bgs. Soil in the separator area was excavated to a depth of approximately 18 ft bgs. The degreaser pit excavations was backfilled with clean fill soil and finished with 8 inches of concrete. The separator area excavation was backfilled with gravel (Shaw Environmental, 2004). The treatability study was conducted in two Stages: (1) anaerobic ISB, and (2) aerobic ISB. Reducing conditions conducive to the biodegradation of the chlorinated organics within the treatability study wells were established during the anaerobic stage. Reductive dechlorination of the chlorinated ethenes and chlorinated benzenes occurred once highly reducing conditions were established. Introduction of oxygen to the treatability study area successfully facilitated aerobic biodegradation of nonchlorinated organics and residual reduced chlorinated organics. Oxygen delivery was accomplished using iSOC™ technology, or an *in situ* Submerged Oxygen Curtain. Data confirmed that the addition of the oxygen stimulated the indigenous microorganisms, thus degrading the remaining chlorobenzene and benzene.
- A fuel tank farm was once located at IR-06 adjacent to and southwest of Building 134. The 16 aboveground storage tanks and two pump house buildings were removed in 1993, as described in PRC (1996). Subsequent excavations of this area and the fuel lines from the former fuel tank farm, not including IR-25, were completed under the Parcel B remedial design. Details of the excavations are described in IT (1998) and TtEMI (2002).

More details of these remediation activities are provided in Section 2.3.2 of the Work Plan.

1.1.7 Principal Decision Makers

The principal decision makers for this project include the U.S. Navy, the regulatory agencies, and the public. These decision makers will use the data collected to address issues regarding contamination at the boundary between Parcels B and C in the RU-C5 area.

1.1.8 Regulatory Framework

Under Executive Order 12580, the U.S. Navy is the lead agency responsible for the cleanup effort. The U.S. EPA, the California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB) provide regulatory oversight.

The site investigation activities at RU-C5 will be conducted under the IR Program. Activities are performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan.

Additional information on the regulatory framework for the project is provided in Section 3 of the Work Plan.

1.2 Project Description

The following sections discuss the objectives and measurements of the RU-C5 project. Figure A-12 presents the schedule for field work and reporting.

1.2.1 Project Objectives

The objectives of this investigation are to:

1. Assess the lateral extent of dissolved-phase VOCs in shallow groundwater (the A-aquifer) along the boundary between Parcels B and C near RU-C5.
2. If dissolved-phase VOCs from RU-C5 have migrated across the boundary into Parcel B, delineate the resulting lateral extent in shallow groundwater in Parcel B.
3. Evaluate the lateral extent of VOCs as DNAPLs, if present, by collecting and analyzing groundwater samples at the interface between the unconsolidated sediments and bedrock.

1.2.2 Project Measurements

Analytical methods were selected to meet the Data Quality Objectives (DQOs) for this project and to maintain consistency and comparability with previously collected data. The following measurements will be performed:

- Groundwater VOC concentrations from samples collected using a Hydropunch[®] (EPA Method 8260B), and

- Groundwater VOC concentrations from samples collected from existing monitoring wells (EPA Method 8260B).

1.2.3 Quality Objectives and Criteria

Managing the quality of data requires that objectives be established for the data as a basis against which the quality can be assessed. This section describes the DQO process, analytical data quality objectives and indicators, and analytical method requirements.

1.2.4 Data Quality Objectives

The DQO process is an EPA-endorsed strategic planning tool based on the scientific method (EPA, 2000a). This process is used to design data collection activities because it provides systematic procedures for determining when to collect samples, where to collect samples, how many samples to collect, and what analyses to perform. This approach assists in determining the tolerable level of error associated with the decisions the data are intended to support. DQOs are qualitative and quantitative statements that:

- Clarify study objectives,
- Define appropriate types and amount of data to collect,
- Determine appropriate conditions (e.g., location and time) for data collection, and
- Specify tolerable limits on decision errors.

Using the DQO process to plan field activities ensures that the type, quantity, and quality of data used in making decisions are appropriate for the intended use of the data. The structure of the DQO process also provides a convenient way to describe decisions and communicate the sampling and analysis design to others. The DQO process provides an important focus for a SAP by encouraging data users to clarify their objectives and limit the number of decisions that are made. The DQO process includes seven steps:

1. State the problem,
2. Identify the decisions,
3. Identify the decision inputs,
4. Define the study boundaries,
5. Develop the decision rules,
6. Specify tolerable limits on decision errors, and
7. Optimize the sampling design.

The DQOs for the RU-C5 contamination delineation investigation are:

Step 1. Problem: VOCs in groundwater in the dissolved phase and/or as DNAPLs are not adequately characterized along the boundary between Parcels B and C in the RU-C5 area. Additional information is needed to determine if VOCs have migrated across the boundary, and if so, at what concentrations.

Step 2. Decisions:

1. Have VOCs in the dissolved phase migrated across the boundary between Parcels B and C?
2. Have VOCs as DNAPLs from the former sump and dip tank (IR-25) migrated downward through discontinuities in the Bay Mud to the underlying undifferentiated sediments?
3. If DNAPLs are present beneath the Bay Mud, have these DNAPLs migrated laterally along the interface between the undifferentiated sediments and bedrock?

Step 3. Inputs: The data inputs include:

1. VOC concentration data from groundwater samples collected using a Hydropunch[®] and from existing monitoring wells.
2. Lithologic data from previous investigations and the soil cores included in this SAP. Emphasis will be placed on evaluating the depth, thickness, and continuity of low permeability sediments.

Step 4. Boundaries: The lateral boundaries of the investigation extend approximately 300 ft to each side of the boundary between Parcels B and C. The vertical boundary is the top of the bedrock. The temporal boundary for the investigation is 2005-2006.

Step 5. Decision Rules:

1. If a VOC analyte is present in a groundwater (Hydropunch[®]) sample collected along the boundary between Parcels B and C in the RU-C5 area at a concentration exceeding the reporting limits described in Section 2.3.1 (Project Analytical Requirements), these data will be interpreted to indicate that the VOC has migrated laterally across the Parcel boundary at the sample location and further delineation of the plume will be performed. If the VOC concentrations in samples collected along the Parcel boundary are below reporting limits, these data will be interpreted to indicate that the lateral extent of VOC contamination is limited to Parcel C in the RU-C5 area.
2. If elevated concentrations of VOCs are detected at the interface between the unconsolidated sediments and bedrock, these data will be interpreted to indicate the potential presence of DNAPLs below the Bay Mud. Site data will be reviewed and professional judgment will also be used to identify the potential presence of DNAPLs.

Step 6. Limits on Decision Errors: Statistically derived limits on sampling design error are not quantifiable because a judgmental sampling strategy will be used. To minimize sampling error, samples will be collected using standard methodologies, and to the extent appropriate, in a manner consistent with previously collected data. To minimize analytical error, standard analytic methods will be used. The scope of the current investigation will be limited to identifying contamination at concentrations exceeding the Project-Required Quantitation Limits presented in Section 2.3.1.

Step 7. Optimized Sampling Design: Data obtained from previous investigations has been used to identify sampling locations and depths, the data from the completed passive soil gas survey has been used to optimize groundwater sampling locations, and the soil coring described in this SAP will be used to optimize sampling depths.

1.2.5 Measurement Quality Objectives

Precision, accuracy, representativeness, completeness, and comparability (PARCC) criteria are the qualitative and quantitative indicators of data quality. PARCC criteria are defined and discussed in the following sections.

1.2.5.1 Precision

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is determined for analytical results using field and laboratory duplicates and duplicate matrix spike (MS) samples. It is expressed in terms of the relative percent difference (RPD) as follows:

$$RPD = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100$$

where:

C_1 = concentration of sample or MS, and

C_2 = concentration of duplicate or matrix spike duplicate (MSD).

1.2.5.2 Accuracy

Accuracy is the degree of agreement of a measurement (or an average of the same measurement type) with an accepted reference or true value. Accuracy of analytical determinations will be measured using laboratory QC analyses such as laboratory control samples (LCSs), MSs, and surrogate spikes. Accuracy is typically measured by evaluating the QC result against the concentration known to be added, expressed as percent recovery (%R) as follows:

$$\%R = \frac{S - U}{C_{sa}} \times 100$$

where:

- S = Measured concentration of spiked aliquot,
- U = Measured concentration of unspiked aliquot, and
- C_{sa} = Concentration of spike added.

1.2.5.3 Representativeness

Representativeness is the reliability with which a measurement or measurement system reflects the true conditions under investigation. Representativeness is influenced by the number and location of the sampling points, sampling timing and frequency of monitoring efforts, and the field and laboratory procedures.

1.2.5.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. Data validation and data quality assessment will determine which data are valid and which data are rejected. Percent completeness is defined as follows:

$$\text{Percent Completeness} = \frac{V}{T} \times 100$$

where:

- V = Number of valid (not rejected) measurements over a given time, and
- T = Total number of planned measurements.

The completeness goal for this project will be 90 percent for validated project data.

1.2.5.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another based on using EPA-defined procedures, where available. If EPA procedures are not available, the procedures have been defined or referenced in this SAP.

The comparability of data will be established through well-documented methods and procedures, standard reference materials, QC samples and surrogates, and performance-evaluation study results as well as by reporting each data type in consistent units.

1.2.5.6 Detection and Quantitation Limits

The method detection limit (MDL) is the minimum concentration of an analyte that can be reliably distinguished from background noise for a specific analytical method. The quantitation limit represents the lowest concentration of an analyte that can be quantified accurately and reproducibly in a sample matrix. Project-Required Quantitation Limits (PRQLs) are contractually specified maximum quantitation limits for specific analytical methods and sample matrices, such as soil or water, and are typically several times the MDL to allow for matrix effects.

Selected analytical methods and associated PRQLs are typically capable of quantifying contaminants of concern at concentrations below the most stringent screening criteria. The PRQLs reflect the maximum sensitivity of current, routinely used analytical methods. PRQLs for the RU-C5 contamination delineation project are presented in more detail in Section 2.3 (Analytical Methods).

For this project, samples analyzed for organic compounds will be reported as estimated values if the concentrations are less than the PRQLs but greater than the MDLs or one-half the PRQLs, whichever is greater, except for compounds analyzed by gas chromatography/mass spectrometry, which will be reported as estimated values down to the MDLs.

1.2.6 Project Organization

Table A-1 presents the project roles and contact information for key U.S. Navy, CE2, Kleinfelder, and regulatory individuals involved in the RU-C5 contamination delineation project. A project organization chart is provided as Figure A-13. QA/QC positions and responsibilities are shown on Table A-2. The CE2 Corporate QA Officer is responsible for maintaining the official, approved SAP.

1.3 Special Training and Certification

The following sections outline any special training and certification required to perform the activities described in this SAP.

1.3.1 Safety and Health Training

Safety and health requirements for this project are presented in the Site-Specific Safety and Health Plan (Appendix B). Prior to the start of field activities, personnel assigned to perform the work will receive project orientation, which includes review of the Site-Specific Safety and Health Plan and Activity Hazard Analyses.

1.3.2 Subcontractor Training

Other than the project orientation and the safety and health training presented in the Site-Specific Safety and Health Plan (Appendix B), no additional subcontractor training is

required. All subcontractors working on the site will certify that their employees have been trained for work on hazardous waste sites. Training will meet Occupational Safety and Health Administration (OSHA) requirements defined in 29 CFR 1910.120(e). Before work begins on the project site, subcontractors will submit copies of the training certification for each employee to the Site Safety and Health Officer (SSHO).

Personnel assigned to the project will be competent and qualified to perform the tasks required by the scope of work by: (1) receiving the appropriate training and instruction, and (2) being familiar with the relevant project procedural documents.

1.3.3 Specialized Training and Certification Requirements

Technical work will be supervised by a California Professional Geologist in accordance with the Business and Professions Code, Division 3, Chapter 12.5, and CCR Title 26, Chapter 29. Subcontractors will be appropriately licensed by the State of California if required by the scope of their work on the project.

1.4 Documents and Records

Documentation is critical for evaluating the success of any environmental data collection activity. The following sections discuss the requirements for documenting field activities and for preparing laboratory data packages. This section also describes reports that will be generated as a result of this project.

1.4.1 Field Documentation

A permanently bound field logbook with sequentially numbered pages, used for sampling activities only, will be assigned to the project. Entries will be recorded in indelible black or blue ink. At the end of each workday, the logbook pages will be signed by the responsible sampler, and any unused portions of the logbook pages will be crossed out, signed, and dated.

If it is necessary to transfer the logbook to another person, the person relinquishing the logbook will sign and date the last page used, and the person receiving the logbook will sign and date the next page to be used.

At a minimum, the logbook will contain the following information:

- Project name and site location,
- Date and time,
- Name and affiliations of onsite personnel or visitors,
- General weather information,
- Work performed,
- Field observations,
- Sampling performed, including specifics such as location, type of sample, type of analyses, and sample identification,

- Field analyses performed, including results, instrument checks, problems, and calibration records for field instruments,
- Descriptions of deviations from this SAP or other governing documents,
- Problems encountered and corrective action taken,
- Verbal or written instructions, and
- Any other events that may affect the samples.

Changes or corrections on any project documentation will be made by crossing out the item with a single line, initialing by the person performing the correction, and dating the correction. The original item, although erroneous, will remain legible. The new information will be written above the crossed-out item. Corrections will be written clearly and legibly with indelible black or blue ink.

1.4.2 Laboratory Data Package Format

Although the analyses are not explicitly those of the Contract Laboratory Program (CLP), the laboratory will prepare summary and full data packages in accordance with EPA CLP guidance (EPA, 1999). The summary data package will consist of a case narrative, copies of associated chain-of-custody (COC) forms, sample results, and quality assurance QA/QC summaries. The case narrative will include the following information:

- Laboratory name, project name, project order number, sample delivery group (SDG) number, and a table that cross-references client and laboratory sample identification numbers,
- Detailed documentation of sample shipping and receiving, preparation, analytical, and quality deficiencies,
- Thorough explanations of instances of manual integration,
- Copies of associated nonconformance and corrective action forms that describe the nature of the deficiency and the corrective action taken, and
- Copies of associated sample receipt notices.

Full data packages will contain the information from the summary data package and associated raw data.

1.4.3 Electronic Laboratory Data Submittal

The laboratory will provide electronic data deliverables (EDD) for analytical results in compliance with NFECSW Environmental Work Instruction EVR-6 (U.S. Navy, 2005). An automated laboratory information management system (LIMS) will be used to produce the EDDs. Manual creation of the deliverable (data entry by hand) is unacceptable. The laboratory will verify EDDs internally before they are issued. The EDDs will correspond exactly to the hard-copy data. No duplicate data will be submitted. EDDs will be delivered in a format compatible with U.S. Navy Electronic Data Deliverable (NEDD) standard. Results that will be included in the EDDs are:

- Target analyte results for each sample and associated analytical methods requested on the COC form,
- Method and instrument blanks and preparation and calibration blank results reported for the SDG,
- Percent recoveries for the spike compounds in the MS, MSDs, blank spikes, or LCSs,
- Matrix duplicate results reported for the SDG, and
- All reanalysis, reextraction, or dilutions reported for the SDG, including those associated with samples and the specified laboratory QC samples.

Electronic and hard-copy data must be retained for a minimum of 3 and 10 years, respectively, after final data have been submitted. CE2 will use an electronic storage device capable of recording data for long-term, off-line storage. Raw data will be retained on an electronic data archival system.

1.4.4 Reports Generated

The results of the site characterization will be reported in a Technical Memorandum reviewed and signed by a California-licensed Professional Geologist. The Technical Memorandum will include, at a minimum:

- Descriptions of field activities and methodologies used,
- Analytical data,
- Isoconcentration maps,
- Lithologic descriptions from soil cores,
- Interpretations of the results, and
- Recommendations.

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2.0 Data Generation and Acquisition

The following sections discuss sampling process design, sampling methods, sample handling, analytical methods, quality control, equipment and instruments, supplies and consumables, and data management.

2.1 Sampling Process Design

The following sections describe the design of the sampling process to be utilized for the contamination delineation project at RU-C5.

2.1.1 Investigation Design

The site investigation will be performed using a strategy designed to accomplish the following project objectives:

1. Assess the lateral extent of dissolved-phase VOCs in shallow groundwater (the A-aquifer) along the boundary between Parcels B and C near RU-C5.
2. If dissolved-phase VOCs from RU-C5 have migrated across the boundary into Parcel B, delineate the resulting lateral extent in shallow groundwater in Parcel B.
3. Evaluate the lateral extent of VOCs as DNAPLs, if present, by collecting and analyzing groundwater samples at the interface between the unconsolidated sediments and bedrock.

The general approach to achieving these objectives is:

1. Initially, collect lithologic and groundwater VOC concentration data along the Parcel B/C boundary.
2. Review these data and collect additional data on both sides of the Parcel B/C boundary.
3. Collect groundwater samples from five existing monitoring wells in the RU-C5 area that are not currently part of the Basewide Groundwater Monitoring Program.

The following sections present more details on the individual components of the investigation design. Descriptions of the sampling equipment and methodologies are provided in Section 2.1.5.

2.1.1.1 Soil Coring

Continuous soil cores will be collected from the ground surface to bedrock encounter at five locations using Direct-Push Technology (DPT). The cores will be described as presented in Section 2.1.5.2. Logs from nearby previous borings will also be reviewed. The soil cores will also be field-screened using a Photo-Ionization Detector (PID) calibrated for the VOCs anticipated to be present. The primary objectives of these lithologic characterization activities are to: (1) identify the depths of permeable sediments from which HydroPunch[®] groundwater

samples will be collected, (2) determine the presence of the Bay Mud or other low-permeability strata that may serve to separate the upper from the lower A-aquifer, (3) identify the presence of DNAPLs at the interface between the unconsolidated sediments and bedrock.

Proposed boring locations are shown on Figure A-14. These locations were selected in consideration of:

1. The availability of lithologic information from previous site investigations. The locations of the soil cores are intended to provide new information, rather than duplicate previous efforts.
2. The slope of the bedrock surface (dipping approximately north), which may control the migration of potential DNAPLs from the sump and dip tank release area in IR-25.

Soil samples from the cores will not be submitted for laboratory analysis unless evidence of DNAPL is observed.

2.1.1.2 Groundwater Sampling using Hydropunch®

Groundwater samples will be collected using a Hydropunch® at 50 locations. At 40 of these locations, groundwater samples will be collected from the upper A-aquifer to quantify concentrations of dissolved VOCs. At 10 other locations, samples will be collected from both the upper A-aquifer and from the interface between the unconsolidated sediments and bedrock. The objective of collecting the deeper samples is to identify potential VOCs as DNAPLs. The groundwater samples will be analyzed for VOCs using EPA Method 8260B, plus naphthalene.

The proposed sampling locations are shown on Figure A-14. These locations were selected in consideration of:

1. The locations where dissolved-phase VOCs are most likely to have crossed the Parcel B/C boundary, as suggested by previous site data (cross-sections, the distribution of VOCs in groundwater, and the general groundwater flow direction). The results of the August-September 2005 passive soil gas survey were also considered; Figure A-14 shows isoconcentration contours for total VOCs from the soil gas survey.
2. Areas where VOCs as DNAPLs may be present, based on lithologic data, the orientation of bedrock, the presence and continuity of the low-permeability Bay Mud unit, DNAPLs identified in previous investigations, and the presence of high concentrations of dissolved-phase VOCs.

As indicated previously, the locations along the Parcel B/C boundary will be sampled first. After review of the analytical results of these samples, the remainder of the samples will be collected. This will optimize the investigation by focusing on the locations where VOCs (either in dissolved phase or as DNAPLs) may have crossed the boundary into Parcel B.

The depths from which the groundwater samples will be collected will be selected in consideration of:

1. The anticipated depth to groundwater in the upper A-aquifer (approximately 5 to 10 ft bgs in the RU-C5 area, but location-dependent).
2. Lithologic information from previous investigations and the soil cores presented in this SAP, particularly as pertain to the depth to the low-permeability Bay Mud unit and the depth to bedrock.
3. The results of the qualitative field screening of the soil cores using a PID.

2.1.1.3 Monitoring Well Sampling

Ground water samples will be collected from existing five monitoring wells completed in the A-aquifer in Parcels B and C that:

1. Are not currently sampled as part of the Basewide Groundwater Monitoring Program (TtEMI, 2004), and
2. Are appropriately located and screened to facilitate the delineation of the lateral and/or vertical extent of VOCs in groundwater released at RU-C5.

The wells to be sampled are:

- IR06MW34A,
- IR06MW46A,
- IR25MW37B,
- IR25MW38B, and
- IR25MW39A.

The locations of these wells are shown on Figure A-6.

There are a limited number of monitoring wells in the area that are not sampled as part of the Basewide Groundwater Monitoring Program. Sampling two of the listed monitoring wells (IR25MW38B and IR25MW39A) was requested by the regulatory agencies in comments on the SAP for the Basewide Groundwater Monitoring Program (TtEMI, 2004; Appendix I, page I-153, Comment 6). Wells IR06MW46A and IR25MW37B are completed in the A-aquifer along the boundary between Parcels B and C. Although well IR06MW34A is not located near the boundary between Parcels B and C, obtaining VOC concentration data from this well would support the overall RU-C5 investigation. The samples from the wells will be analyzed for VOCs using EPA Method 8260B, plus naphthalene.

Each well will be inspected and sounded prior to sampling to verify its condition. If a well is not able to be sampled, an alternate well meeting the project objectives will be substituted.

2.1.2 Rationale for Selecting Analytical Parameters

The analytical parameters were based on historical data and the U.S. Navy's objective of evaluating contaminant concentrations along the boundary between Parcels B and C in the RU-C5 area. Analysis for VOCs using EPA Method 8260B for groundwater samples will result in analytical data appropriate to support the objectives of the investigation.

2.1.3 Surveying

Sampling locations will be surveyed for position and elevation relative to mean sea level by a Registered Land Surveyor. The following standards will be used, as specified in NFECSW Environmental Work Instruction EVR-6 (U.S. Navy, 2005):

- NEDD Horizontal: State Plane Coordinate System NAD 83 (ft).
- EDF Horizontal: Latitude and Longitude (decimal degrees).
- NEDD and EDF Vertical: Mean Sea Level, NAVD88 (ft).

2.1.4 Underground Utility Survey

Before performing excavation/drilling/coring activity, USA Dig-Alert (1-800-227-2600) will be contacted and as-built plans will be reviewed. A subcontracted utility locator will supplement USA Dig-Alert's demarcations. Subsurface intrusive work will not proceed until locating activities have been completed and documented in the site records. The safety orientation meeting for onsite field personnel will include: (1) reviewing of a map of known or suspected underground utilities, and (2) conducting a site walkover to familiarize personnel with the locations of known or suspected utilities.

For drilling in areas where the presence of underground utilities is known or suspected, a hand auger will be advanced a minimum of 5 ft below ground surface (bgs) prior to powered drilling operations. Any locations or areas where hand augering is not required will be approved by the U.S. Navy.

If personnel encounter a subsurface condition where previously unidentified underground utilities are suspected: (1) work will cease, (2) equipment will be secured, and (3) the Project Manager and Site Safety and Health Officer (SSHO) will be notified.

2.1.5 Sampling Methods and Equipment

2.1.5.1 Direct-Push Technology

Direct-Push Technology (DPT) will be used to obtain soil cores and Hydropunch[®] groundwater samples. DPT uses a truck-mounted hydraulic/percussion system to push a 2.5-inch diameter steel rods with a drive point to the desired sampling depth. After sampling is complete, the rods will be retrieved and the boreholes will be backfilled using neat cement, bentonite, or cement/bentonite mixture.

2.1.5.2 Soil Coring

Continuous soil cores will be collected from the ground surface to bedrock encounter. The cores will be described and relevant information recorded on boring logs. Materials encountered in the borehole will be classified at minimum of 5-ft intervals using the Unified Soil Classification System (USCS). Lithologic conditions, depth to ground water, and other information will be recorded. Logging will include, but not limited to, gross lithology, USCS code, and Munsell Color (wetted sample). For matrix-supported sediments, estimates of plasticity, toughness, and dilatancy will be described. The degree and type of cementation, and pedogenic (soil-formed) structures (e.g., blocks, plates, root bores etc.) will also be described. For grain-supported sediments such as sand units, total grain size range, modes, angularity/roundness, and gross mineralogy will be described. Cementation, and sedimentary structures (laminae, ripples, cross-laminae, etc.) will also be described. Stratigraphic contacts will be described as sharp or gradational, and estimated depths of contacts in nonsampled interval will be assessed by changes in penetration rate, and via cuttings. Moisture conditions will be qualitatively described.

The soil cores will also be field-screened using a PID calibrated for the VOCs anticipated to be present. More than one PID may be needed to detect the entire range of potential VOCs. The PID measurements will be considered qualitative and used only to identify depth intervals where elevated VOC concentrations may be present.

2.1.5.3 Groundwater Sampling using Hydropunch[®]

Groundwater samples will be collected using a Hydropunch[®] sampler consisting of an expendable drive point, drive head, protective sheath, and inner stainless-steel screen. A drive rod will be added to the top of the sampler and the entire assembly driven into the subsurface using the percussion of the DPT rig. By adding a series of hollow, hardened-steel drive rods, the sampler will be advanced to the desired depth. Once the desired depth is reached, extension rods will be placed down the center of the drive rods to push out the expendable drive point and to hold the screen in position as the rods are retracted approximately 4 ft. The screen is thus exposed to the aquifer and fills with groundwater. Groundwater samples will be collected by placing a polyethylene tube with a bottom check valve into the screen. The tubing will be gently moved up and down to minimize volatilization, resulting in water flow through the check valve through the tube to the ground surface.

If groundwater flow into the screen is extremely slow, the sampling equipment will be withdrawn and a small diameter temporary PVC well screen will be inserted into the borehole. This will allow the DPT rig to move to the next sampling location while enough groundwater to sample enters the temporary well. The groundwater sample will be collected using the polyethylene tube and check valve system described previously.

For the deep groundwater samples, the methodology described above will be employed, except that the technique of withdrawing the sampling equipment and inserting a temporary PVC well screen will not be used to avoid the possibility of shallow groundwater flowing downward through the borehole and potentially cross-contaminating the deep groundwater sample. All deep groundwater samples will be collected from the Hydropunch[®] screen.

Samples will be collected directly into precleaned, laboratory-supplied sample containers. The VOC vials will be filled to a positive meniscus and the absence of bubbles within the vial will be visually verified by inverting the container after closure. If bubbles are detected, the cap will be removed and a small amount of additional groundwater added to the container until a positive meniscus is once again formed. The vial will then be rechecked for bubbles and the procedure continued until no bubbles are present in the sample vial.

2.1.5.4 Groundwater Sampling from Existing Monitoring Wells

The collection of groundwater samples from existing monitoring wells will be conducted using the procedures presented in the SAP for the Basewide Groundwater Monitoring Program (TtEMI, 2004). In summary, the procedures are:

1. Inspect monitoring well for damage and/or maintenance issues. Note findings on monitoring well sampling sheet.
2. Position electrical generator as far away as practical and downwind of monitoring well.
3. Keep ice chest/cooler in shade away from electrical generator. Maintain adequate ice to maintain samples at approximately 4° Celsius until shipment to the analytical laboratory.
4. Measure and record depth to water and total depth of well.
5. Use a PID to monitor ambient air near monitoring well.
6. Use new Teflon-lined polyethylene tubing for each well. If appropriate, retrieve dedicated sample tubing from the monitoring well.
7. Connect the sample tubing to the stainless-steel low-flow submersible pump.
8. Wells will be sampled by placing the pump intake in the center of the screened interval or the center of the saturated screened interval, as determined by depth to water measurements and well construction information.
9. Connect sample tubing to flow cell. Use Horiba U-10 water quality meter and Oakton Instrument Tester 10 oxidation-reduction probe. Put outflow hose for purge water into container.
10. Start purging groundwater through flow cell. Record the initial water quality parameters (temperature, specific conductance, pH, turbidity, and dissolved oxygen) on monitoring well sampling sheet. Begin pumping at a rate between 0.05 and 0.5 L/min and adjust discharge between these rates until drawdown stabilizes.
11. Record purge-water parameters at 1 liter intervals.
12. Purge at least 8 liters of groundwater. After parameters have stabilized (three successive measurements of water parameters within solubility range), change gloves and collect groundwater samples directly from sample tubing.
13. If well draws down excessively (water level declines below pump inlet), wait until well recharges to 80% of initial water level before taking sample. Excessive

drawdown is considered to be a drawdown greater than 25% of the original water column above the pump intake.

14. Fill VOA bottles. Be careful not to overfill any bottles. Do not flush out preservatives, if any are used. VOA bottles require no headspace. The VOA bottles will be filled to a positive meniscus and the absence of bubbles within the vial will be visually verified by inverting the container after closure. If bubbles are detected, the cap will be removed and a small amount of additional groundwater added to the container until a positive meniscus is once again formed. The vial will then be rechecked for bubbles and the procedure continued until no bubbles are present in the sample vial.
15. As appropriate, collect QA/QC samples such as duplicates and MS/MSD samples.
16. Record sample time and personnel initials on the label for each bottle. Immediately place bottles in ice chest/cooler after filling.
17. Decontaminate all sampling equipment with the three-stage bucket system. All portions of the electronic water-level indicators exposed to groundwater will be decontaminated before each use by washing with a mixture of tap water and Liqui-Nox[®] soap solution and rinsed with tap water followed by deionized water. Submersible pumps and flow-through cells will be decontaminated before each use by washing the exterior of each pump with deionized water and Liqui-Nox[®] soap solution and then pumping a solution of deionized water and Liqui-Nox[®] soap through the pump. The pump will then be flushed with tap water followed by deionized water.
18. Collect rinsate sample (if any) using fresh deionized water.
19. If appropriate, return dedicated sample tubing to well.
20. Close and lock monitoring well. Remove sample equipment from area.

2.1.6 Decontamination

All nondisposable field equipment must be thoroughly cleaned and decontaminated before and after each use at each sampling location to obtain representative samples and to reduce the possibility of cross-contamination. The following procedure will be used:

1. Wash with nonphosphate detergent and water solution (e.g., Alconox[®] or Liqui-Nox[®] solutions made as directed by the manufacturer).
2. Rinse with potable water. Change the water frequently. This step will decrease the gross contamination and reduce the frequency at which the nonphosphate detergent and water solution need to be changed.
3. Rinse twice with deionized water and allow to air-dry.
4. Containerize decontamination water pending characterization and disposal.

2.1.7 Management of Investigation-Derived Waste

IDW will be disposed of according to the methods and procedures described in the IDW Management Plan (Appendix C).

2.1.8 Sample Containers and Holding Times

Sample containers, preservation, and holding time requirements will be according to the requirements presented in Table A-3. The analytical laboratories will provide the sampling containers. Sample containers will be certified precleaned according to EPA protocols. The laboratory will guarantee the purity of preservation chemicals.

2.2 Sample Handling and Custody

The following sections describe sample handling procedures, including sample identification and labeling, documentation, chain-of-custody (COC), and shipping.

2.2.1 Sample Identification

Samples collected during the project will be assigned a unique sample identification number that is compatible with the computerized data management system. This sample numbering system will allow the sample to be tracked from collection through laboratory analysis. The sample numbering system includes the week and year of the sampling, the sampler's initials, and a consecutive number that lists the number of samples collected by the sampler for the event.

To maintain sample identification integrity, no two samplers will use the same initials for sample identification numbers. If any samplers have the same initials, the sample tracking log will assign unique letters to use. The consecutive sample number will be assigned to each sampler for the duration of the sampling event. Sample numbers will be unique.

The sample identification numbers will be written on the field notebook, on the COC form, and any field sampling forms to track the sample throughout the process.

The field QC samples for this project are field duplicates, equipment rinsates, trip blanks, and source water blanks. If necessary, a field blank may be collected during sampling. If a field blank is collected, it will be analyzed for the same analytes as the equipment rinsates. Conditions such as strong winds or nearby excavations may require collection of field blanks, but it is unlikely that field blanks will be necessary during sampling. Field duplicates and blanks will be designated by a consecutive sample identification number at the time of collection.

Additional sample volume will be collected for MS/MSD groundwater samples. MS/MSD samples are assigned a sample identification number in the same manner of regular samples.

2.2.2 Sample Labels

Sample labels will be completed using indelible ink and will be affixed to sample containers at the time of sample collection. Sample labels will contain the following information, at a minimum:

- Project name and location
- Sample identification number,
- Date of sample collection (month/day/year),
- Time of sample collection (24-hour clock),
- Sampler's initials,
- Analyses required,
- Preservative (if any).

Sample labels will be covered with wide, clear tape. Groundwater samples will be refrigerated to maintain sample temperature at 4° Celsius plus or minus 2°.

2.2.3 Sample Documentation

To ensure that analytical results are correctly matched with field locations, field personnel will maintain field documentation following the general procedure outlined below:

- Documentation will be completed in permanent black or blue ink,
- Entries will be legible,
- Errors during documentation will be correcting using a single line strike-through, followed by the date and field personnel initials, and
- Unused portions of pages will be crossed out, and the last page for each day will be signed and dated.

2.2.4 Chain-of-Custody

Sample COC procedures will be followed to maintain sample integrity from sample collection through analysis. A sample is considered to be in custody if:

- The sample is in a person's physical possession or view,
- The sample is in a secure area with restricted access, or
- The sample is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal.

COC procedures ensure that an accurate written record exists to track the possession of individual samples from the time of collection to the time of acceptance at the laboratory. The

COC record provides documentation of samples collected and the specific analyses requested. The field personnel will record the following information on each COC record:

- Project name and number,
- Sampling location,
- Name and signature of sampler,
- Laboratory name,
- Sample identification number,
- Date and time of sample collection,
- Number and type of containers filled,
- Analysis requested,
- Preservatives used (if applicable),
- Filtering (if applicable),
- Sample designation (grab or composite),
- Signatures of individuals involved in custody transfer, including the date and time of transfer,
- Airbill number (if applicable), and
- Project contact and phone number.

Field personnel will cross out and initial unused lines on the COC record and sign records that are initiated in the field. If a commercial carrier service is used for sample transport, the airbill number will be recorded on the COC record. Once completed, the COC record will be placed in a waterproof plastic bag and taped to the inside lid of the shipping container used for sample transport. Field personnel will retain copies of the COC record after transport.

Laboratory COC begins when samples are received and continues until samples are discarded. Laboratories analyzing samples for this project must follow custody procedures at least as stringent as are required by the EPA CLP Guidance (EPA, 1999). The laboratory should designate a specific individual as the sample custodian. The custodian will receive incoming samples, sign the accompanying custody forms, and retain copies of the forms as permanent records. The laboratory sample custodian will record pertinent information concerning the samples, including the persons delivering the samples, the date and time received, sample condition at the time of receipt (sealed, unsealed, or broken container; temperature; or other relevant information), the sample identification numbers, and any unique laboratory identification numbers for the samples. This information should be entered into a computerized LIMS. The sample custodian must notify CE2 immediately if there is any problem with the samples upon arrival.

When the sample transfer process is complete, the laboratory custodian is responsible for maintaining internal logbooks, tracking reports, and other records necessary to maintain custody throughout sample preparation and analysis. The laboratory will provide a secure storage area

for samples. Access to this area will be restricted to authorized personnel. The custodian will ensure that samples requiring special handling, including samples that are heat- or light-sensitive, radioactive, or have other unusual physical characteristics will be properly stored and maintained before analysis.

2.2.5 Sample Shipment

The following procedures will be implemented when groundwater samples collected during this project are shipped:

- Sample containers will be placed in resealable plastic bags with a signed and dated custody seal placed over the opening of each bag such that the seal would be torn if the bag were opened. The bags will be wrapped in bubble wrap to prevent breakage.
- The cooler will be filled with bubble wrap, sample bottles, and packing material. Sufficient packing material will be used to prevent sample containers from breaking during shipment. Enough ice will be added to maintain the sample temperature at 4 °C plus or minus 2 °C.
- The COC records will be placed inside a plastic bag. The bag will be sealed and taped to the inside of the cooler lid. The air bill, if required, will be filled out before the samples are handed over to the carrier. The laboratory will be notified if the sampler suspects that the sample contains any substance that would require laboratory personnel to take safety precautions.
- The cooler will be closed and will be taped shut with strapping tape around both ends. If the cooler has a drain, it will be taped shut both inside and outside of the cooler.
- Signed and dated custody seals will be placed on the front and side of each cooler.
- The COC record will be transported within the cooler. When the cooler is received at the analytical laboratory, laboratory personnel will open the cooler and sign the COC record to document transfer of samples.
- Multiple coolers may be sent in one shipment to the laboratory. The outside of the coolers will be marked to indicate the number of coolers in the shipment.

2.3 Analytical Methods

Analytical methods were selected to provide data of the necessary quality to meet the DQOs for this project and to maintain the consistency and comparability of the data. The groundwater samples will be analyzed for VOCs using EPA Method 8260B.

2.3.1 Project Analytical Requirements

The laboratory will follow the requirements of the analytical methods used for this project, including QC samples and associated control limits, calibration requirements; and miscellaneous method performance requirements unless noted otherwise in this SAP. The laboratory procedures will incorporate U.S. Navy QA policy as well as applicable EPA and state QA guidelines, as appropriate.

Table A-4 presents the individual analytes and PRQLs for groundwater (EPA Method 8260B). Although not included in the standard EPA Method 8260B, naphthalene has been added to the analyte list.

The analytical laboratories will attempt to achieve these PRQLs for the samples collected. If problems occur in achieving the PRQLs, the laboratories will contact the Project Chemist immediately, and other alternatives will be pursued to achieve acceptable reporting limits. In addition, results below the reporting limit but above the Method Detection Limit (MDL) will be reported with appropriate flags to indicate the greater uncertainty associated with these values. The laboratory's standard analyte lists and reporting limits for analytical methods should be followed, unless additional analytes and/or other project-required reporting limits are specified in this SAP. All quantifiable results will be reported.

The standard data package requirements will be consistent with Table 6 of the SAP for the Basewide Groundwater Monitoring Program (TtEMI, 2004).

2.3.2 Laboratory Selection

Agriculture and Priority Pollutants Laboratory (APPL) is located in Fresno, California. APPL is certified by the State of California ELAP and the U.S. Navy IR QA Program. APPL will perform the groundwater analyses as specified in the SAP for the Basewide Groundwater Monitoring Program (TtEMI, 2004). APPL will analyze the groundwater samples for VOCs using EPA Method 8260B, plus naphthalene.

2.4 Quality Control

The primary functions of a sampling and analysis program are to obtain accurate, representative environmental samples and to provide defensive analytical data. A program for evaluating field and laboratory data is developed to achieve these goals. The quality of field data will be assessed through regular collection and analysis of field QC samples. Laboratory QC samples will also be analyzed in accordance with referenced analytical method protocols to ensure that laboratory procedures are conducted properly and that the quality of the data is known. The following sections discuss the types of QC samples to be collected and analyzed for this project and their role in ensuring that project data are acceptable.

2.4.1 Field Quality Control Samples

QC samples are collected in the field and are used to evaluate the validity of the field sampling effort. Field QC samples will be collected for laboratory analyses to check sampling and analytical precision, accuracy, and representativeness. The types of field QC samples that will be used for this project are discussed in the following sections.

2.4.1.1 Field Duplicates

Field duplicate samples will be collected for the groundwater samples. Field duplicates are two samples of the same matrix, collected at the same location and time (to the extent possible), with an assumed level of overall homogeneity within the sample matrix. The same sampling

techniques and analytical methods are performed on both samples. Analysis of field duplicates provides a quantitative measure of the precision of the overall sampling and analysis process as the sum of contributions from sample heterogeneity, the precision of the sampling process, and the analytical method(s). Field duplicates are uniquely identified so that the identity of the field duplicates is unknown to the analytical laboratory. The locations of field duplicate samples and their identifications will be recorded in the field logbook.

Groundwater duplicate samples will be collected at a frequency of one per ten groundwater samples collected.

2.4.1.2 Matrix Spike and Matrix Spike Duplicates

The types of QC spike samples the laboratory will use include LCSs (or method blank spikes), MSs, and surrogates. An LCS is a clean matrix (i.e., the same used for a method blank) spiked with known concentration(s) of target analyte(s). The LCS will be carried through the entire analytical procedure to assess the overall accuracy of the method. An MS is an aliquot of a parent sample spiked with target analyte(s) of known concentration(s) prior to sample preparation. The impact of the sample matrix on target analyte recovery (i.e., accuracy and precision) will be assessed by QC sampling MSs and MSDs. A surrogate is a nontarget analyte spiked at a known concentration prior to sample preparation. Surrogate analytes will be used to monitor method performance on a matrix-specific/sample-specific basis.

Each analytical preparation batch must contain an MS/MSD pair. Matrix QC samples will be analyzed with each batch of 20 or fewer groundwater samples analyzed by the laboratory. An additional volume of groundwater sample will need to be collected for the MS/MSD pair.

2.4.1.3 Trip Blanks

Trip blanks are used to detect contamination introduced during sample handling and shipment. For groundwater, a trip blank originates at the laboratory as a 40 mL vial filled with contaminant-free, reagent-grade water and is shipped to the field with sample containers. The trip blanks are not opened in the field and are returned to the laboratory in every sample cooler containing samples to be analyzed. One trip blank will accompany each sample cooler that holds water samples for VOC analysis that is shipped to the laboratory.

2.4.1.4 Equipment Rinsate Samples

An equipment rinsate sample is a sample of contaminant-free water that has been passed through or over recently decontaminated field sampling equipment. An equipment rinsate sample will be used to assess the adequacy of the equipment decontamination process as well as contaminant effects from handling, storage, shipment, and analysis. Equipment rinsate samples will be collected at a frequency of one per day.

2.4.1.5 Source Water Blank Samples

Source water blanks will be used to assess the potential for sample contamination from the final rinse water of the decontamination process. One source water blank from each water

source will be collected and analyzed for the same parameters as the related samples. After the initial source water blank sample, additional samples will only be collected when the source of rinse water changes.

2.4.2 Laboratory Quality Control Samples

Laboratory QC samples are analyzed to evaluate the quality of preparation and analysis of field samples. Laboratory QC samples are prepared and analyzed at the laboratory to assess analytical precision, accuracy, and representativeness. Table 4 of the SAP for the Basewide Groundwater Monitoring Program (TtEMI, 2004) provides the required frequencies for laboratory QC samples, and Appendix A of that document includes project-specific precision and accuracy goals for these samples. The types of laboratory QC samples that will be used for this project are discussed in the following sections.

2.4.2.1 Method Blanks

Method blanks are prepared to determine whether contamination of the field samples is occurring in the laboratory during sample preparation or analysis. A method blank consists of organic-free water (groundwater analyses) and is prepared and analyzed by the same methods and procedures and for the same parameters as those for the field samples. Method blanks will be prepared at the frequency prescribed in the individual analytical method or at a rate of 5 percent of the total samples if a frequency is not prescribed in the method.

2.4.2.2 Laboratory Control Samples or Blank Spikes

An LCS or blank spike originates in the laboratory as deionized or distilled water that has been spiked with standard reference materials of known concentration. An LCS or blank spike is analyzed to verify the accuracy of the analytical system. LCSs, or blank spikes, will be analyzed at the frequency prescribed in the analytical method or at a rate of 5 percent of the total samples if a frequency is not prescribed in the method. If percent recovery results for the LCS or blank spike are outside of the established goals, the entire batch of samples associated with the LCS must be reextracted and/or reanalyzed, and other laboratory-specific protocols will be followed to gauge the usability of the data.

2.4.2.3 Surrogate Standards

Surrogate standards consist of known concentrations of nontarget organic analytes that are added to each sample, method blank, and MS/MSD before samples are prepared and analyzed. The surrogate standard measures the efficiency the analytical method in recovering the target analytes from an environmental sample matrix. Surrogate standards provide an indication of laboratory accuracy and matrix effects for every field and QC sample that is analyzed by gas chromatography for volatile and extractable organic constituents. Surrogate compounds are used in the analysis of VOCs to monitor purge efficiency and analytical performance, whereas surrogates are used in the analysis of extractable organic compounds to monitor the extraction process and analytical performance.

Guidelines for surrogate recovery for this project are provided in Appendix A of the SAP for the Basewide Groundwater Monitoring Program (TtEMI, 2004). Laboratory personnel are required to reextract (if applicable) and reanalyze samples when results for associated surrogates are outside control limits. Data from both analyses of the samples in question are reported.

2.4.2.4 Internal Standards

Internal standards are compounds that are added to every VOC standard, method blank, MS/MSD, and sample or sample extract at a known concentration before analysis. Internal standards are used as the basis for quantification of gas chromatography/mass spectrometry target compounds and ensure that the gas chromatography/mass spectrometry sensitivity and response are stable during the analytical run. An internal standard is used to evaluate the efficiency of the sample introduction process and monitors the efficiency of the analytical procedure for each sample matrix encountered. Internal standards may also be used in the analysis of organic compounds by gas chromatography to monitor retention-time shifts.

2.4.3 Additional Laboratory Quality Control Procedures

In addition to the analysis of laboratory QC samples, the laboratories will conduct the QC procedures discussed in the following sections.

2.4.3.1 Method Detection Limit Studies

The MDL is the minimum concentration of a compound that can be measured and reported. The MDL is a specified limit at which there is 99 percent confidence that the concentration of the analyte is greater than zero. The MDL takes into account sample matrix and preparation.

MDL studies will be conducted annually for each matrix or more frequently if any method or instrumentation changes. Each MDL study will consist of seven replicates spiked with target analytes of interest at concentrations no greater than required quantitation limits. The replicates will be extracted and analyzed in the same manner as routine samples. If multiple instruments are used, each will be included in the MDL study. The MDLs reported will be representative of the least sensitive instrument.

2.4.3.2 Instrument Detection Limit Studies

The Instrument Detection Limit (IDL) is the minimum concentration of a compound that can be distinguished from background noise by an analytical instrument. The IDL is a measurement of instrument sensitivity and does not take into account sample matrix and preparation.

2.4.3.3 Sample Quantitation Limits

Sample quantitation limits (SQL), also referred to as practical quantitation limits, are PRQLs adjusted for the characteristics of individual samples. The PRQL is usually defined in the analytical method or in laboratory method documentation. The SQL takes into account changes in the preparation and analytical methodology that may alter the ability to detect an analyte, including changes such as use of a smaller sample aliquot or dilution of the sample extract.

Physical characteristics such as sample matrix and percent moisture that may alter the ability to detect the analyte are also considered. The laboratory will calculate and report SQLs for environmental samples.

2.4.3.4 Control Charts

Control charts document data quality in graphic form for specific method parameters such as surrogate standards and blank spike recoveries. A collection of data points for each parameter is used to statistically calculate means and control limits for a given analytical method. This information is useful in determining whether analytical measurement systems are in control. In addition, control charts provide information about trends over time in specific analytical and preparation methodologies. Although they are not required, it is recommended that laboratories maintain control charts for organic and inorganic analyses. At a minimum, method-blank surrogate recoveries and blank spike recoveries should be charted for organic methods. Control charts should be updated monthly.

2.4.3.5 Additional Laboratory Quality Control Procedures

For organic analyses performed with two columns, the laboratory should report the lowest result from the two columns as the final result to minimize the quantitation of matrix interference as a target analyte. Also, the laboratory should report the percent difference between the two results.

If LCS recoveries are out of control limits, the samples in the batch associated with the LCS should be reanalyzed. If the samples were extracted, they must be reextracted before being reanalyzed. If surrogate spike recoveries are out of control limits, then the samples must be reanalyzed to confirm the out-of-control recoveries; both runs should be reported.

If the concentration of a target analyte is over the calibrated range, the sample should be rerun at a dilution such that the highest-concentration target analyte is on-scale and in the upper half of the calibrated range of the analyte. Dilution runs should be reported in their entirety along with the original analyses. Dilution is not applicable for passive soil gas analyses.

2.5 Equipment Testing, Inspection, and Maintenance

This section outlines the testing, inspection, and maintenance procedures that will be used to keep both field and laboratory equipment in good working condition.

2.5.1 Maintenance of Field Equipment

Preventive maintenance for most field equipment is carried out in accordance with procedures and schedules recommended in: (1) the equipment manufacturer's literature or operating manual, or (2) standard operating procedures (SOPs) that describe equipment operation associated with particular applications of the instrument. A field instrument that is out of order will be segregated, clearly marked, and not used until it is repaired. The Project Manager will be notified of equipment malfunctions so that service can be completed quickly or substitute equipment can be obtained. When the condition of equipment is suspect, unscheduled testing,

inspection, and maintenance should be conducted. Any significant problems with field equipment will be reported in the daily field report.

2.5.2 Maintenance of Laboratory Equipment

Laboratories will prepare and follow a maintenance schedule for each instrument used to analyze samples collected for this project. Instruments will be serviced at scheduled intervals necessary to optimize factory specifications. Routine preventive maintenance and major repairs will be documented in a maintenance logbook.

An inventory of items to be kept ready for use in case of instrument failure will be maintained and restocked as needed. The list will include equipment parts subject to frequent failure, parts that have a limited lifetime of optimum performance, and parts that cannot be obtained in a timely manner.

The laboratory's QA plan and written SOPs will describe specific preventive maintenance procedures for equipment maintained by the laboratory. These documents identify the personnel responsible for major, preventive, and daily maintenance procedures, the frequency and type of maintenance performed, and procedures for documenting maintenance activities.

Laboratory equipment malfunctions will require immediate corrective action. Actions should be documented in laboratory logbooks. No other formal documentation is required unless data quality is adversely affected or further corrective action is necessary. Corrective actions will be taken as necessary in accordance with the procedures described in the laboratory QA plan and SOPs.

2.6 Instrument Calibration and Frequency

The following sections discuss calibration procedures that will be followed to ensure the accuracy of measurements made using field and laboratory equipment.

2.6.1 Calibration of Field Equipment

Field equipment will be calibrated at the beginning of the field effort and at prescribed intervals. The calibration frequency depends on the type and stability of equipment, the intended use of the equipment, and the recommendation of the manufacturer. Detailed calibration procedures for field equipment are available from the manufacturer's instruction manual. Calibration information will be recorded in a field logbook or on field forms. A label that specifies the scheduled date of the next calibration will be attached to the field equipment. If this type of identification is not feasible, equipment calibration records will be readily available for reference.

Daily calibration before the day's sampling is suggested for the water quality and turbidity meters, preferably by a designated person.

2.6.2 Calibration of Laboratory Equipment

Procedures and frequencies for calibration of laboratory equipment will follow the requirements of the analytical method used. Qualified analysts will calibrate laboratory equipment and document the procedures and results in a logbook.

The laboratory will obtain calibration standards from commercial vendors for both inorganic and organic compounds and analytes. Stock solutions for surrogate standards and other inorganic mixes will be made from reagent-grade chemicals or as specified in the analytical method. Stock standards will also be used to make intermediate standards that will be used to prepare calibration standards. Special attention will be paid to expiration dating, proper labeling, proper refrigeration, and freedom from contamination. Documentation on receipt, mixing, and use of standards will be recorded in the appropriate laboratory logbook. Logbooks must be permanently bound. Additional specific handling and documentation requirements for the use of standards may be provided in laboratory QA plans.

2.7 Inspection and Acceptance of Supplies and Consumables

The Project Manager has primary responsibility for identifying the types and quantities of supplies and consumables needed to complete this project and is responsible for determining acceptance criteria for these items.

Supplies and consumables can be received either at the CE2 office or at the HPS work site. When supplies are received at an office, the Project Manager (or designee) will sort them according to vendor, check packing slips against purchase orders, and inspect the condition of supplies before they are accepted for use on a project. If an item does not meet the acceptance criteria, deficiencies will be noted on the packing slip and purchase order and the item will be returned to the vendor for replacement or repair.

Procedures for receiving supplies and consumables in the field are similar. When supplies are received, the Project Manager (or designee) will inspect items against the acceptance criteria. Any deficiencies or problems will be noted in the field logbook, and deficient items will be returned for immediate replacement.

Analytical laboratories are required to provide certified clean containers for analyses. These containers must meet EPA standards described in "Specifications and Guidance for Obtaining Contaminant-Free Sampling Containers" (EPA, 1992).

2.8 Non-Direct Measurements

No data for project implementation or decision-making will be obtained from nondirect measurement sources.

2.9 Data Management

Field and analytical data collected for the RU-C5 contamination delineation study will be managed in compliance with the Naval Installation Restoration Information Solution (NIRIS)

program and NFECSW Environmental Work Instruction No. 6 (U.S. Navy, 2005). The NIRIS program is used by NAVFAC Facility Engineering Centers to maintain and access U.S. Navy and Marine Corps Installation Restoration Program data. This program includes a web-accessible database and electronic data delivery standards.

Field and analytical data will be uploaded directly into the NIRIS database after the review and data validation process is completed. This database contains a multitude of useful applications including web-based mapping. Use of the database will allow CE2 to extract data into Excel spreadsheets, extract Geographic Information (GIS) data, and to use query tools.

The following sections describe the data management strategy for the RU-C5 contamination delineation investigation.

2.9.1 Data Tracking Procedures

Data generated by the contamination delineation study at RU-C5 will be entered into the NIRIS database. The other information may include invoicing for laboratory and validation tasks and information related to sample delivery.

2.9.2 Data Pathways

Data for the RU-C5 contamination delineation study will be generated during field activities, from laboratory analyses, and from data validation. CE2 will submit data generated from this study using the Naval Electronic Data Deliverable (NEDD) standard into the NIRIS database.

Data generated during the field activities will be recorded on field forms. The Project QC Manager will review the forms for accuracy and completeness. The data recorded on the field forms will be entered into the sample tracking database.

Laboratory data generated from sample analysis will be recorded electronically and on hard copy. The laboratory will send the electronic and hard copy records to the Project Chemist, who will review the records for accuracy, completeness, and format. The data generated from laboratory analysis will then undergo a validation process. After data validation, the Project Chemist will review the data for accuracy and enter the data qualifiers.

The Project Chemist will submit the data into the NIRIS database using the NEDD data checker process.

2.9.3 Data Management Strategy

The NIRIS database includes information such as environmental and IR GIS data, site documents, land use control information, and administrative records. This database will provide central storage and management for data. The database can be used to provide data for scientific analysis, report preparation, and graphic representations of studies at HPS.

2.9.4 Electronic Data Delivery to the U.S. Navy

Data generated from the contamination delineation study will be submitted directly into the NIRIS database using NEDDs. CE2 will match data files to the NEDD tables, upload the text files into a personal workspace, and use the three-stage data checking process. After the NEDD tables are verified against the NIRIS database, CE2 will complete a submittal form with contact information and comments for the NIRIS Data Manager. Submission of the NEDD deliverables will automatically transfer them to the NIRIS Data Manager and emails will be sent to the U.S. Navy RPM and any other contacts listed on the submittal form. Within 10 days, the NIRIS Data Manager will send CE2 an email with a successful load response, questions, or rejection of the NEDD deliverables.

NEDDs should be submitted to the NIRIS database as soon as the data generated from the contamination delineation study is checked and compiled.

3.0 Assessment and Oversight

This section describes the field and laboratory assessments that are planned during this project, the individuals responsible for conducting assessments, corrective actions that may be implemented in response to assessment results, and how quality-related issues will be reported.

3.1 Assessment and Response Actions

CE2 and the U.S. Navy will participate in the assessment and audit activities described in the following sections. Problems encountered during an assessment of field investigation or laboratory activities will require appropriate corrective action to ensure that the problems are resolved. This section describes the types of assessments planned, CE2 and U.S. Navy responsibilities for conducting the assessments, and the procedures for implementing corrective action procedures to address problems identified during an assessment.

3.1.1 Field Assessments

CE2 and the U.S. Navy Quality Assurance Officer (QAO) may schedule audits of field activities at any time to evaluate the execution of sample collection, identification, and control in the field. The audit will also include observations of COC procedures, field documentation, instrument calibrations, and field measurements. Field documents and COC records will be reviewed to ensure that entries are printed or written in indelible black or blue ink, dated, and signed. Sampling operations will be reviewed and compared to the requirements of this SAP. The auditor will verify that the proper sample containers are used, the required preservatives are added or are already present in the container, and the documentation of the sampling operation is adequate. Field measurements will be reviewed by random spot-checking to determine that the instrument is within calibration, the calibration is done at the appropriate frequency, and that the sensitivity range of the instrument is appropriate for the project.

3.1.2 Laboratory Assessments

Laboratory oversight by CE2 will include a thorough review of the preliminary report and hard-copy data packages. The information that may be obtained from the data packages consists of:

- Correctness of COC procedures,
- Adherence to method holding times,
- Project reporting limits,
- Spiking levels, frequency, and recovery, and
- Accuracy of analytical methods through the LCSs and surrogates.

3.1.3 Assessment Responsibilities

The personnel conducting assessments will be independent of the activity evaluated. The appropriate personnel to conduct each assessment will be identified and assigned responsibilities

and deadlines for completing the assessment. These personnel may include the Program QC Officer, Project QC Officer, or senior technical staff with relevant expertise and experience in assessment.

When an assessment is planned, a lead assessor will be identified who is responsible for:

- Selecting and preparing the assessment team,
- Preparing an assessment plan,
- Coordinating and scheduling the assessment with the project team, subcontractor, or other organization being evaluated,
- Participating in the assessment,
- Coordinating preparation and issuance of assessment reports and corrective action request forms, and
- Evaluating responses and resulting corrective actions.

After an assessment is completed, the lead assessor will submit an audit report to the U.S. Navy, and other personnel may be included in the distribution as appropriate. Assessment findings will also be included in the Quality Control Summary Report (QCSR) for the project.

The U.S. Navy QAO is responsible for coordinating audits that may be conducted by U.S. Navy personnel under this project. Audit preparation, completion, and reporting responsibilities for U.S. Navy auditors would be similar to those described above.

3.1.4 Field Corrective Action Procedures

Nonconformance identified during the field audit will be recorded on a Nonconformance Report. The Program QC Officer will monitor corrective action documentation, verify implementation of the corrective action, track and analyze the corrective action, and close out corrective action documentation upon completion of the corrective action.

3.1.5 Laboratory Corrective Action Procedures

The laboratory will have a QA/QC and corrective action program that addresses out-of-control situations. Following completion of analyses, laboratory personnel will verify compliance with the minimum QC requirements of the project and the laboratory QA/QC plan. If any of the parameters fall outside the control limits, corrective action will be implemented.

Initial corrective action is to verify that no obvious calculation errors have occurred. If appropriate, reanalysis will be performed. If the reanalysis confirms the initial out-of-control limits result, the chemist will notify the laboratory supervisor, who will initiate the corrective action process. Corrective actions may include, but are not limited to:

- Verification of dilution factors,
- Examination of sample for nonhomogeneity,
- Verification of sample preparation,
- Checking of standard preparation logbook,
- Verification of instrument performance,
- Checking of reagent-grade water purity, and
- Monitoring chemist's method performance for procedure verification.

Notification and prompt involvement of the Project Chemist in the corrective action process are absolutely necessary in determining an appropriate resolution. Corrective action records will document the steps taken in the corrective action process, beginning with a description of the problem and ending with a final resolution. A copy of the corrective action report will be sent to the Project Chemist immediately and will be maintained in the project files at CE2.

Corrective action reports will be maintained by the laboratory in a project file and delivered to CE2 as part of the hard-copy deliverable.

3.2 Reports to Management

Effective management of environmental data collection requires: (1) timely assessment and review of activities, and (2) open communication, interaction, and feedback among project participants. CE2 will use the reports described in the following sections to address project-specific quality issues and to facilitate timely communication of these issues.

3.2.1 Weekly Status Report

CE2 will prepare a weekly progress report summarizing field investigation activities and describing upcoming events. The progress report may include sampling and field measurements, equipment used, contractor and subcontractor personnel on site, QA/QC and health and safety activities, problems encountered, corrective actions taken, deviations from the SAP, and explanations for the deviations. The progress report will be submitted to the U.S. Navy as a Microsoft® Word document attached to an e-mail.

3.2.2 Quality Control Summary Report

CE2 will prepare a Quality Control Summary Report (QCSR) that will be submitted to the U.S. Navy with the final Technical Memorandum for the field investigation. The QCSR will include a summary and evaluation of QA/QC activities, including any field or laboratory assessments completed during the investigation. The QCSR will also indicate the location and

duration of storage for the complete data packages. Particular emphasis will be placed on determining whether project DQOs were met and whether data are of adequate quality to support required decisions.

4.0 Data Validation and Usability

This section describes the procedures that are planned to review, verify, and validate field and laboratory data. This section also discusses procedures for verifying that the data are sufficient to meet the DQOs for the project. Data validation procedures will be consistent with NFECSW Environmental Work Instruction No. 1 (U.S. Navy, 2001).

4.1 Data Review, Verification, and Validation

Validation and verification of the data generated during field and laboratory activities are essential to obtaining defensible data of acceptable quality. Verification and validation methods for field and laboratory activities are presented in the following sections.

4.1.1 Field Data Verification

Project team personnel will verify field data through reviews of data sets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved as soon as possible by seeking clarification from field personnel responsible for data collection. Field personnel will be responsible for following the sampling and documentation procedures described in this SAP so that defensible data are obtained.

Data values that are significantly different from the population are called outliers. A systematic effort will be made to identify any outliers or errors before field personnel report the data. Outliers can result from improper sampling or measurement methodology, data transcription errors, calculation errors, or natural causes. Outliers that result from errors found during data verification will be identified and corrected. Outliers that cannot be attributed to errors in sampling, measurement, transcription, or calculation will be clearly identified in project reports.

4.1.2 Laboratory Data Verification

Laboratory personnel will verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for nonconformance to the requirements of the analytical method. Laboratory personnel will make a systematic effort to identify outliers or errors before they report the data. Outliers that result from errors found during data verification will be identified and corrected. Outliers that cannot be attributed to errors in analysis, transcription, or calculation will be clearly identified in the case narrative section of the analytical data package.

4.1.3 Laboratory Data Validation

An independent CE2 subcontractor will validate laboratory data in accordance with current EPA national functional guidelines (EPA, 1999). The data validation strategy will be consistent with U.S. Navy and HPS installation-specific guidelines. To be consistent with historical data, the qualifiers and subqualifiers listed in Appendix E of the SAP for the Basewide Groundwater Monitoring Program (TtEMI, 2004) will be assigned to the results of data validation.

For this project, 80 percent of the laboratory data will undergo cursory validation (EPA Level III), and 20 percent of the laboratory data will undergo full validation (EPA Level IV).

The Project Chemist will discuss the project requirements, the data validation criteria, and any laboratory performance issues with the data validation subcontractor before the submittal of the first data package for validation and as needed during the course of the project. The Project Chemist will also review the data validation reports upon submittal to ensure that the validation guidelines have been followed, to monitor laboratory performance, and to stay informed about issues potentially affecting the data quality. These issues shall be discussed with the laboratory, the data validators, the Project and Program QC Officers, and the project team as soon as possible to ensure high-quality data are obtained.

4.1.3.1 Cursory Review Validation

Cursory validation will be completed on 80 percent of the summary data packages. The data reviewer is required to request any missing information needed from the laboratory. Elimination of the data from the review process is not allowed. Data will be qualified as necessary in accordance with established criteria. Data summary packages will consist of sample results and QC summaries, including calibration and internal standard data.

4.1.3.2 Full Data Validation

Full validation will be completed on 20 percent of the full data packages. The data reviewer is required to request any missing information needed from the laboratory. Elimination of data from the review process is not allowed. Data will continue through the validation process and will be qualified in accordance with established criteria. Full data packages will consist of sample results, QC summaries, and raw data associated with the sample results and QC summaries.

4.1.3.3 Data Validation Criteria

Table 13 of the SAP for the Basewide Groundwater Monitoring Program (TtEMI, 2004) lists the QC criteria that will be reviewed for both cursory and full data validation. The data validation criteria selected will be consistent with the project-specific analytical methods.

4.1.3.4 Reconciliation with User Requirements

After environmental data have been reviewed, verified, and validated, the data must be further evaluated to determine whether DQOs have been met.

To the extent possible, CE2 will follow EPA's data quality assessment (DQA) process to verify that the type, quality, and quantity of data collected are appropriate for their intended use. DQA methods and procedures are outlined in EPA's "Guidance for Data Quality Assessment, Practical Methods for Data Analysis" (EPA, 2000b). The DQA process includes five steps:

1. Review the DQOs and sampling design,
2. Conduct a preliminary data review,

3. Select a statistical test,
4. Verify the assumptions of the statistical test, and
5. Draw conclusions from the data.

When the five-step DQA process is not completely followed because the DQOs are qualitative, CE2 will systematically assess data quality and data usability. This assessment will include:

- A review of the sampling design and sampling methods to verify that these were implemented as planned and are adequate to support project objectives,
- A review of project-specific data quality indicators for PARCC and quantitation limits to determine whether acceptance criteria have been met.
- A review of project-specific DQOs to determine whether they have been achieved by the data collected, and
- An evaluation of any limitations associated with the decisions to be made based on the data collected.

For example, if data completeness is only 90 percent compared to a project-specific completeness objective of 95 percent, the data may still be usable to support a decision but at a lower level of confidence.

The final Technical Memorandum for the project will discuss any potential impacts of these reviews on data usability and will clearly define any limitations associated with the data.

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Tables

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Table A-1. Project contacts and roles.

Affiliation	Contact	Project Role
Base Realignment and Closure Program Management Office West 1230 Columbia Street San Diego, CA 92101	Mr. Ryan Ahlersmeyer (619) 532-0960	U.S. Navy Remedial Project Manager
Naval Facilities Engineering Command – Southwest Division 1220 Pacific Highway San Diego, CA 92132	Mr. Narciso Ancog (619) 532-3046	U.S. Navy Quality Assurance Officer
Resident Officer in Charge of Construction San Francisco Bay Area 2450 Saratoga Ave., Suite 200 Alameda, CA 94501	Mr. Peter Stroganoff (510) 749-5941	Resident Officer in Charge of Construction
Resident Officer in Charge of Construction San Francisco Bay Area 2450 Saratoga Ave., Suite 200 Alameda, CA 94501	Mr. Andy Uehisa (510) 749-5946	Resident Officer in Charge of Construction Technician
Caretaker Site Office Hunters Point Shipyard 410 – Palm Avenue, Building 1, Suite 161 San Francisco, CA 94130	Mr. Michael Mentink (415) 743-4729	Caretaker Site Office
Caretaker Site Office Hunters Point Shipyard 410 Palm Avenue, Building 1, Suite 161 San Francisco, CA 94130	Mr. Doug Delong (415) 743-4713	Caretaker Site Office
U.S. Environmental Protection Agency, Region IX 75 Hawthorne Street San Francisco, CA 94105-3901	Mr. Michael Work (415) 972-3024	Regulatory Remedial Project Manager
California Environmental Protection Agency Department of Toxic Substances Control Office of Military Facilities 700 Heinz Ave., Bldg. F, Suite 200 Berkeley, CA 94710	Mr. Tom Lanphar (510) 540-3776	Regulatory Remedial Project Manager
California Regional Water Quality Control Board 1515 Clay Street, Suite 1400 Oakland, CA 94312	Mr. James Ponton (510) 622-2300	Regulatory Remedial Project Manager
CE2 Corporation 7901 Stoneridge Drive, Suite 505 Pleasanton, CA 94588-3655	Mr. Edward Kilduff (925) 963-0299	Program Manager
CE2 Corporation 7901 Stoneridge Drive, Suite 505 Pleasanton, CA 94588-3655	Mr. Robert Ferry (925) 872-7264	Project Manager

Table A-1. Project contacts and roles (continued).

Affiliation	Contact	Project Role
CE2 Corporation 7901 Stoneridge Drive, Suite 505 Pleasanton, CA 94588-3655	Mr. Mohammad Abri (925) 373-9606	Corporate Quality Assurance Officer
Kleinfelder, Inc. 1970 Broadway, Suite 710 Oakland, CA 94612	Mr. Gary Goodemote (510) 628- 9000	Project Quality Control Manager
Kleinfelder, Inc. 3077 Fite Circle Sacramento, CA 95827	Mr. Richard Bohrer (916) 366-1701	Program Safety and Health Officer
CE2 Corporation 7901 Stoneridge Drive, Suite 505 Pleasanton, CA 94588-3655	Mr. John Copland (510) 292-5032	Project Geologist
Kleinfelder, Inc. 780 Chadbourne Rd., Suite D Fairfield, CA 94585	Ms. Sarah Callahan (707) 429-4070	Site Safety and Health Officer
Kleinfelder, Inc. 1410 F Street Fresno, CA 93706	Mr. Christopher Johnson (559) 486-0750	Project Geologist
Kleinfelder, Inc. 5015 Shoreham Place San Diego, CA 92122	Ms. Melissa Valdovinos (858) 320-2000	Program Chemist

Table A-2. Descriptions of QA/QC positions and responsibilities.

Position	Responsibility
U.S. Navy Quality Assurance Officer	<ul style="list-style-type: none"> • Provides governmental oversight of the project Quality Assurance (QA) Program. • Provides quality-related directives through Contracting Officer Representative. • Provides technical and administrative oversight of surveillance audit activities. • Acts as point of contact for all matters concerning QA and the U.S. Navy's Laboratory QA Program. • Prepares governmental budget estimates for all QA functions included in contracts. • Coordinates training on matters pertaining to generation and maintenance of quality of data. • Authorizes the suspension of project execution if QA requirements are not adequately followed.
Program and Project Managers	<ul style="list-style-type: none"> • Issues and authorizes Appointment Letters describing duties/responsibilities and delegating authority. • Issues stop-work order when necessary. • Monitors and controls through audits and surveillance of project activities. • Interfaces directly with the U.S. Navy to maintain awareness in planning and scheduling. • Establishes an overall records management system. • Implements the approved project-specific plans. • Evaluates project-specific procedures and plans. • Evaluates the project schedule and budget.
Corporate and Project QC Officers	<ul style="list-style-type: none"> • Serves as a point of contact for the U.S. Navy Quality Assurance Officer. • Reviews and approves QA/QC plans and revisions. • Periodically evaluates the effectiveness of the QA/QC plans through conducting surveillances, audits, or management assessments. • Assigns, directs, and supports the QA/QC staff. • Trains, qualifies, and evaluates the personnel according to the QA/QC plans. • Reviews project-specific Sampling and Analysis Plans (SAPs) as required. • Directs QA audits.
Project Chemist	<ul style="list-style-type: none"> • Implements contract requirements for chemical data collection. • Audits field and laboratory performance as required. • Approves the selection of subcontract analytical laboratories and data validation companies. • Develops project-specific SAPs. • Evaluates and selects qualified subcontract analytical laboratories and data validation companies. • Implements chemical data QC procedures. • Reviews laboratory data prior to use. • Coordinates data validation of laboratory data. • Reviews data validation reports. • Determines whether project specifications have been met. • Prepares and supports report preparation.
Field Sampling Personnel	<ul style="list-style-type: none"> • Performs all field sampling in accordance with the SAP. • Ensures that field QC samples are collected. • Completes field documentation. • Coordinates laboratory and field sampling activities. • Implements field corrective actions as required.

Table A-3. Sample containers, preservatives, and holding times.

Sample type	Analyte	Analytical Method	Container	Preservative	Holding time
Groundwater	VOCs	EPA Method 8260B	Three 40-mL glass vials with Teflon septa	pH \leq 2 w/HCl. Cool to 4 \pm 2°C	14 days

Notes:

°C – degrees Celsius

EPA – U.S. Environmental Protection Agency

HCl – hydrochloric acid

N/A – not applicable

L – liter

mL – milliliter

VOC – volatile organic compound

Table A-4. Analytes and PRQLs for groundwater samples by EPA Method 8260B.

Analyte	Project-Required Quantitation Limit (µg/L)
Benzene	0.5
Bromobenzene	0.5
Bromodichloromethane	0.5
Bromoform	0.5
Bromomethane	1
Carbon tetrachloride	0.5
Chlorobenzene	0.5
Chloroethane	0.5
Chloroform	0.5
Chloromethane	0.5
1,2-Dibromo-3-chloropropane	2
Dibromochloromethane	0.5
Dibromomethane	0.5
1,2-Dichlorobenzene	0.5
1,3-Dichlorobenzene	0.5
1,4-Dichlorobenzene	0.5
Dichlorodifluoromethane	1
1,2-Dichloroethane	0.5
1,1-Dichloroethane	1
1,1-Dichloroethene	0.5
cis-1,2-Dichloroethene	0.5
trans-1,2-Dichloroethene	0.5
1,2-Dichloropropane	0.5
cis-1,3-Dichloropropene	0.5
trans-1,3-Dichloropropene	0.5
Ethylbenzene	0.5
Freon 113	0.5
Methyl tert-butyl ether	0.5
Methylene chloride	5
Naphthalene	0.5
1,1,1,2-Tetrachloroethane	0.5
1,1,2,2-Tetrachloroethane	0.5
Tetrachloroethene	0.5
Toluene	0.5
1,2,4-Trichlorobenzene	0.5
1,1,1-Trichloroethane	0.5
1,1,2-Trichloroethane	0.5
Trichloroethene	0.5
Trichlorofluoromethane	0.5
1,2,3-Trichloropropane	1
Vinyl chloride	0.5
Xylene	0.5

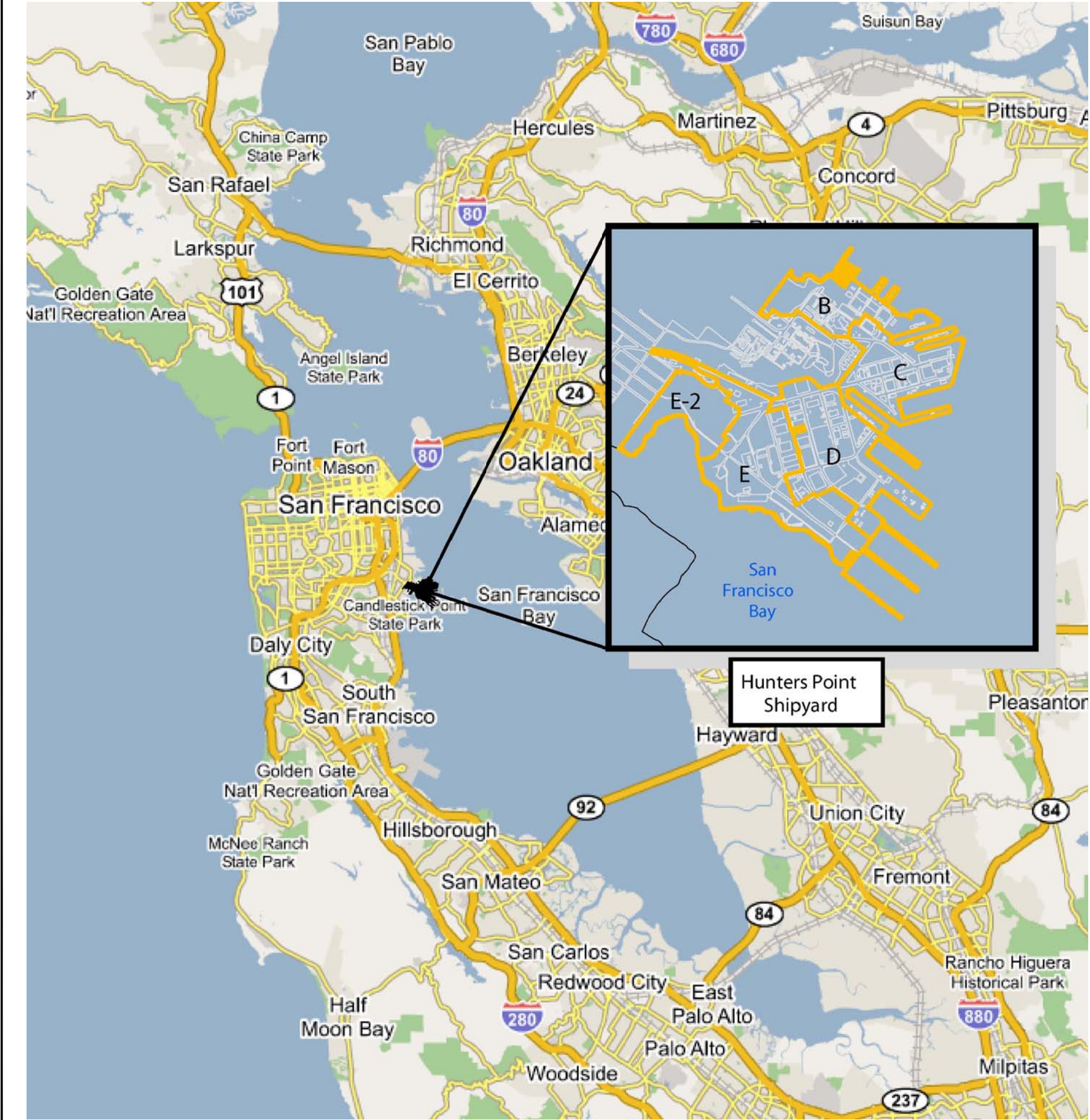
Note: Naphthalene added, but is not on standard list of EPA Method 8260B analytes.

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Figures

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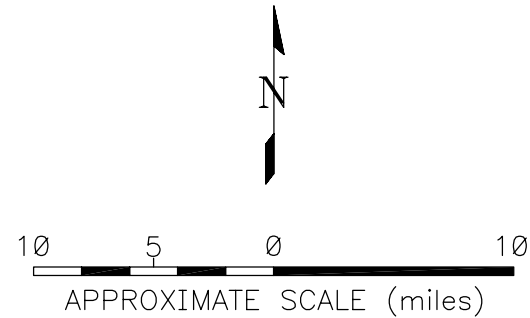
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DRAWN BY: L. Sue

DATE: 11/01/05

CHECKED BY: S. Quayle

REVISED:

SITE LOCATION MAP

FINAL SAP FOR CONTAMINATION DELINEATION AT RU-C5, NOVEMBER 2005
Hunters Point Shipyard, San Francisco, California
U.S. Navy, NFECSW, San Diego, California

PROJECT NO. 19000-021

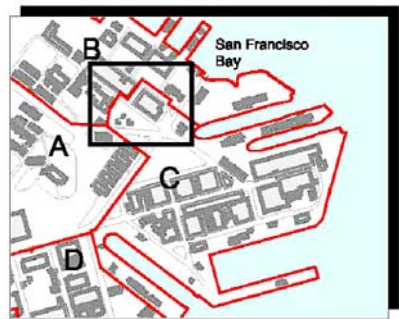
FIGURE

A-1

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Legend

- Potential Contaminant Source Area
- Monitoring Wells
 - Well Screened in Upper Low Permeable A-aquifer Zone
 - Well Screened in Lower A-aquifer Zone
 - Well Screened in both Upper Low Permeable a-aquifer Zone and Lower A-aquifer Zone
 - Well Screened in Deep Bedrock Water-Bearing Zone
 - Boring
 - Treatability Study Borehole
 - Soil Vapor Well
 - Wells Containing DNAPL, 2002
- Historic Steam Line
- Water Utility Line
- Storm Drain Line
- Sanitary Sewer Line
- Submerged Sanitary Sewer Line
- Submerged Storm Drain Line
- Historic Fuel Line
- Cross-Section Location
- Parcel B ROD 1998 to 1999 Excavation
- Observed Excavation 2003
- Parcel C as Built Excavation
- Former Building Location
- Building/Building Number
- Soil-Vapor Extraction Treatability Study, 2001

20 10 0 20
APPROXIMATE SCALE (feet)

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CROSS-SECTION LOCATION MAP

FIGURE

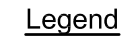
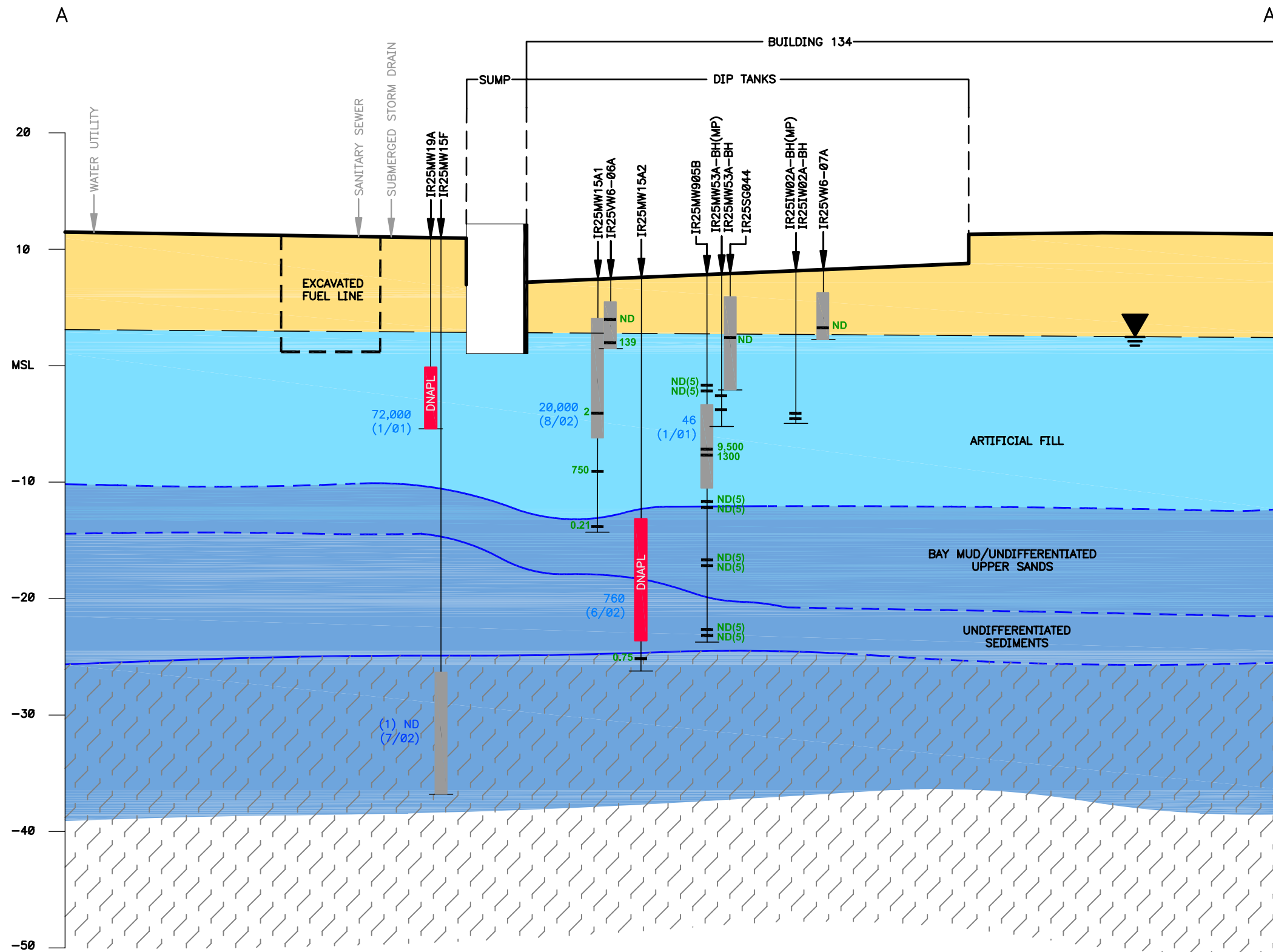
A-2


FINAL SAP FOR CONTAMINATION DELINEATION AT RU-C5, NOVEMBER 2005
Hunters Point Shipyard, San Francisco, California
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PROJECT NO. 19000-021

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DATE: 11/01/05



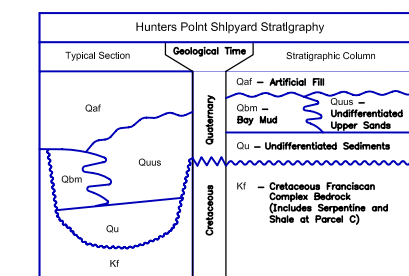
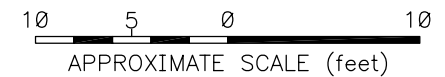
- 
- Formation Contact (dashed where Inferred)
 - Ground Surface
 - Monitoring Well Location.
 - Well Screen
 - DNAPL found in 2002
 - Soil Sample Location
 - Approximate 2002 Waterlevel Elevation
 - 20,000
(8/02) Concentration of PCE (ug/L)
In Groundwater
Date of Sampling and PCE
 - 0.21 Concentration In Soil
[Non-detect results with
detection limit In parenthesis (ug/kg)]

-
- Upper A-Aquifer
- Lower A-Aquifer
- Unsaturated Artificial Fill
- Bedrock

DNAPL	Dense Non-Aqueous Phase Liquid
MSL	Mean Sea Level
ug/L	micrograms per liter
ug/kg	micrograms per kilogram
RU	Remedial Unit

Notes:

1. These cross sections represent one interpretation of the shallow subsurface at RU-C5; alternate Interpretations are possible.
2. Artificial fill consists of low permeable material with higher permeable lenses.
3. Treatability Study Boreholes added.



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CROSS-SECTION A-A'

FIGURE

A-3

FINAL SAP FOR CONTAMINATION DELINEATION AT RU-C5, NOVEMBER 2005
Hunters Point Shipyard, San Francisco, California
U.S. Navy, NFECSW, San Diego, California

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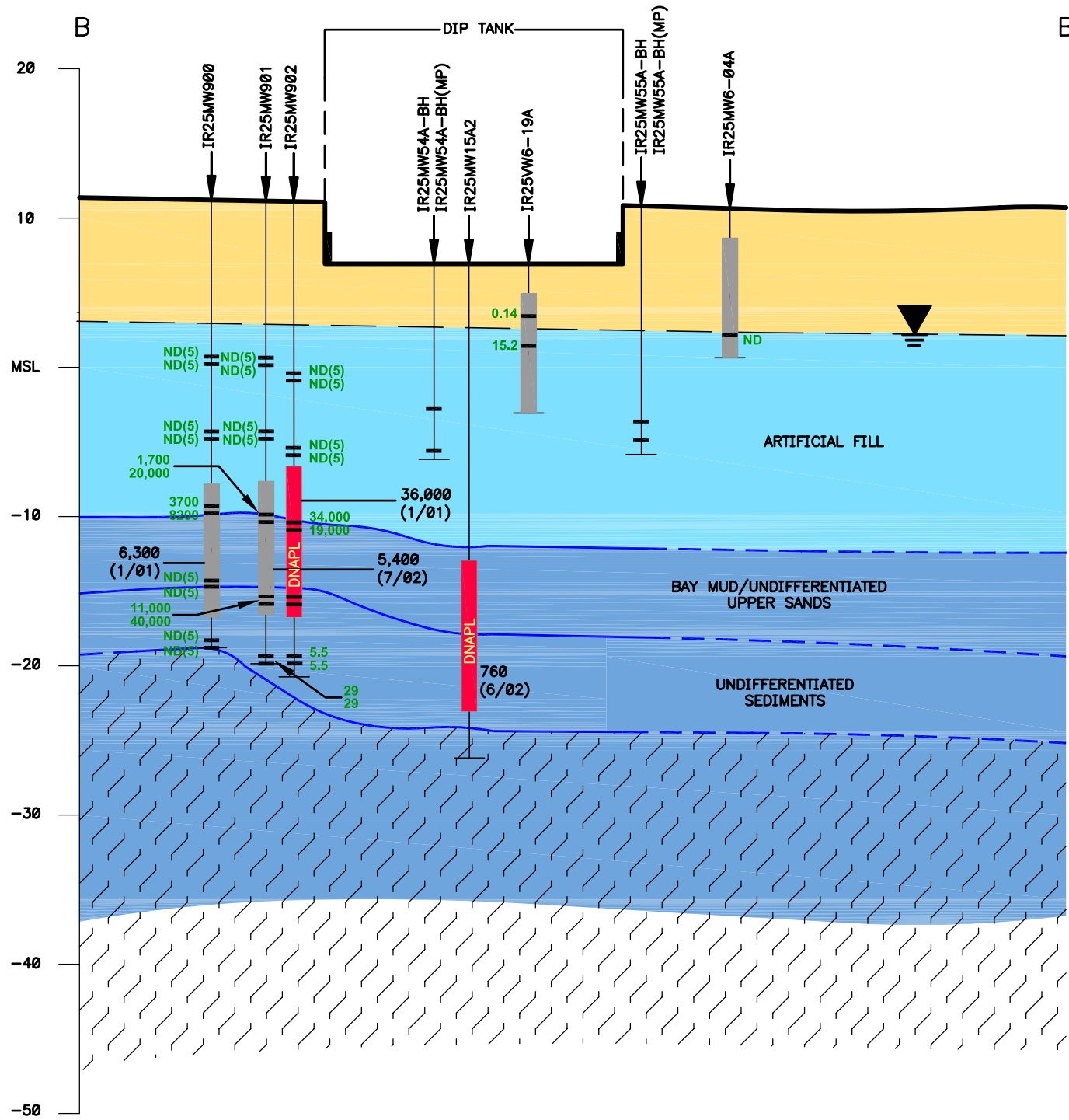
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Legend

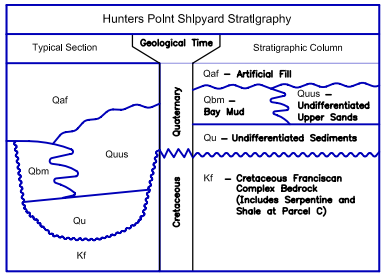
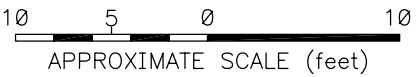
-  Formation Contact (dashed where Inferred)
 Ground Surface
 Monitoring Well Location.
 Well Screen
 DNAPL found in 2002
 Soil Sample Location
 Approximate 2002 Waterlevel Elevation
 20,000
 (8/02) Concentration of PCE (ug/L)
 Date of Sampling and PCE
 0.21 Concentration In Soil
 [Non-detect results with
 detection limit In parenthesis (ug/kg)]

-
- Upper A-Aquifer
- Lower A-Aquifer
- Unsaturated Artificial Fill
- Bedrock

DNAPL	Dense Non-Aqueous Phase Liquid
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ug/L	micrograms per liter
ug/kg	micrograms per kilogram
RU	Remedial Unit

Notes:

1. These cross sections represent one interpretation of the shallow subsurface at RU-C5; alternate Interpretations are possible.
2. Artificial fill consists of low permeable material with higher permeable lenses.
3. Treatability Study Boreholes added.



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CROSS-SECTION B-B'

FIGURE

A-4

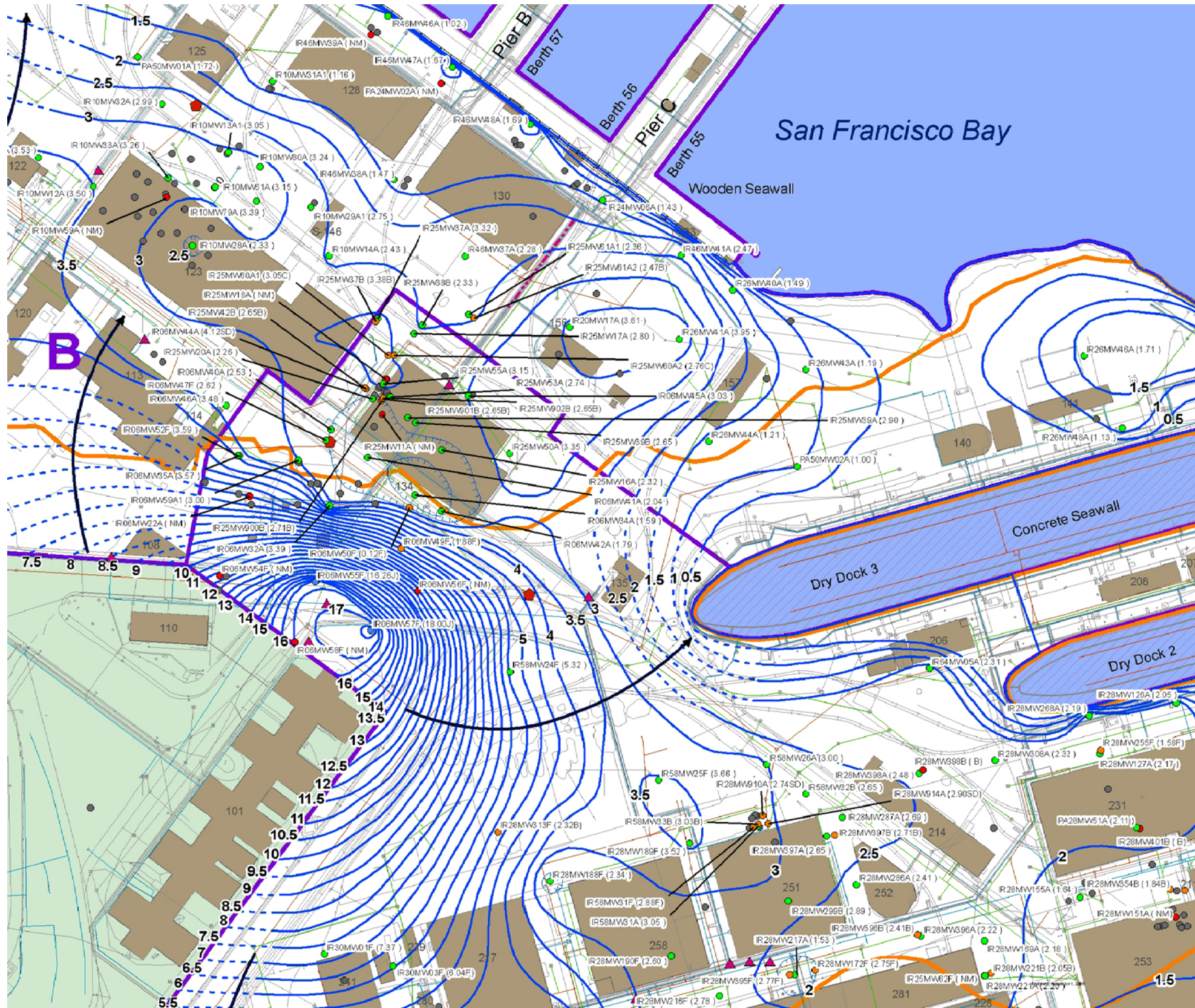
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PROJECT NO. 19000-021

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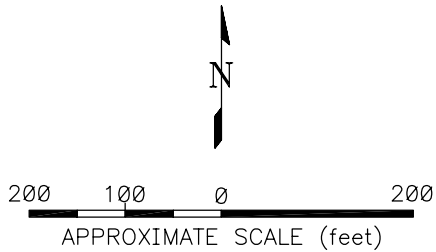
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Legend	
PCE	Tetrachloroethene
TCE	Trichloroethene
DCE	Dichloroethene
VC	Vinyl Chloride
D	Diluted by Laboratory
J	Estimated Concentration



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**DISTRIBUTION OF SELECTED VOCs IN GROUNDWATER,
OCTOBER - DECEMBER 2004**

FINAL SAP FOR CONTAMINATION DELINEATION AT RU-C5, NOVEMBER 2005
Hunters Point Shipyard, San Francisco, California
U.S. Navy, NFECSW, San Diego, California

PROJECT NO. 19000-021

FIGURE

A-6

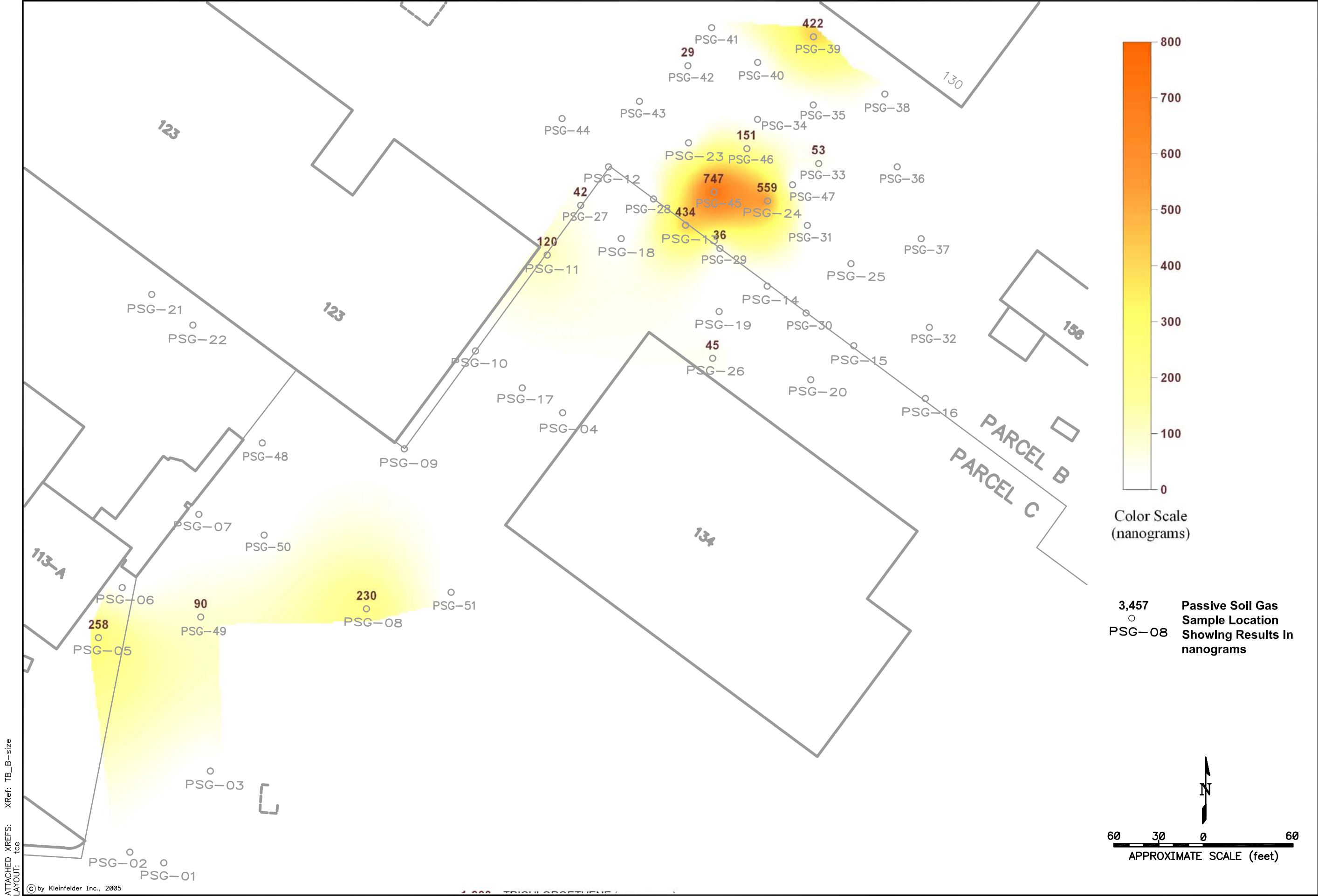


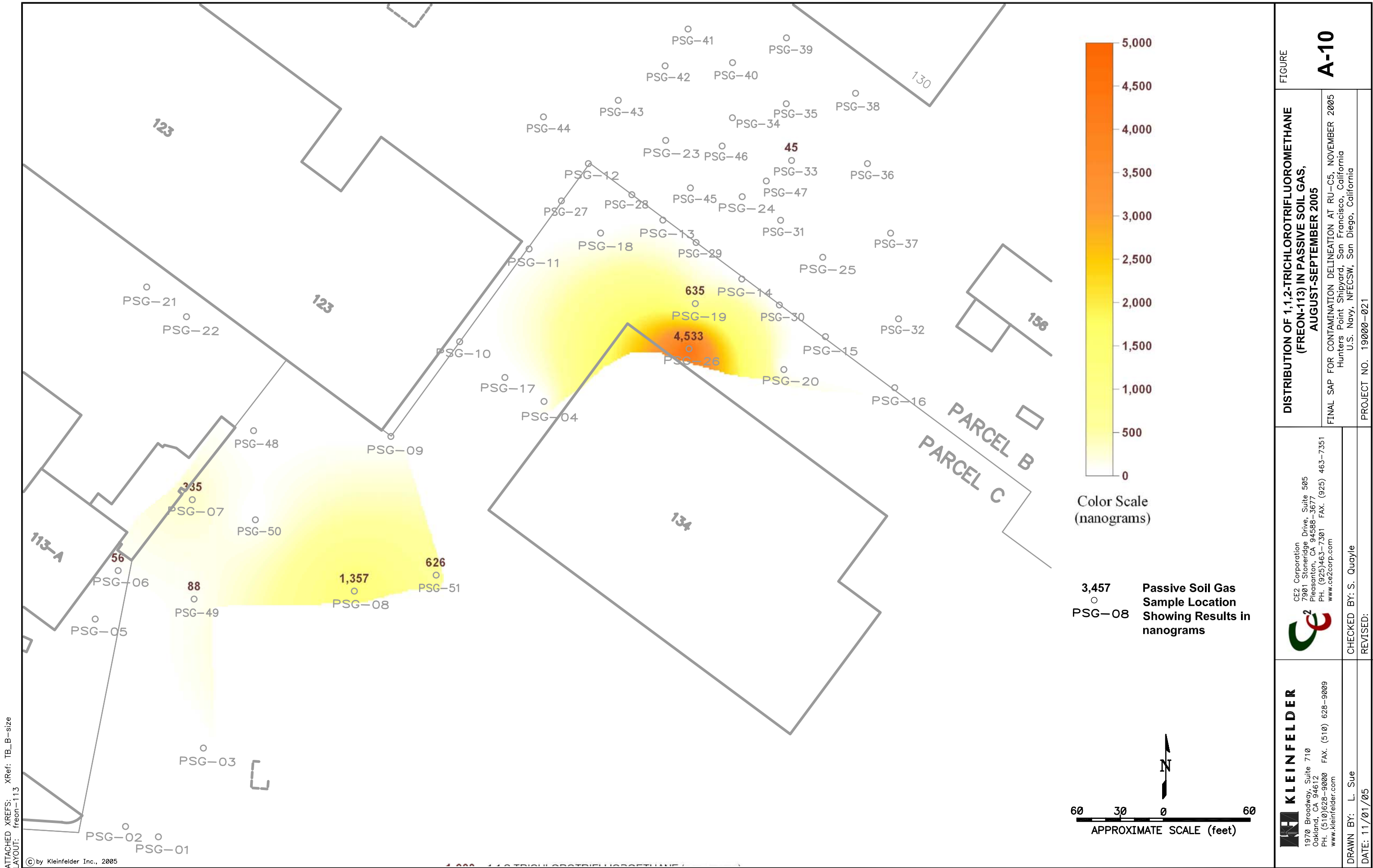
FIGURE		A-7	
DISTRIBUTION OF TCE IN PASSIVE SOIL GAS, AUGUST-SEPTEMBER 2005		FINAL SAP FOR CONTAMINATION DELINEATION AT RU-C5, NOVEMBER 2005 Hunters Point Shipyard, San Francisco, California U.S. Navy, NFECSW, San Diego, California	
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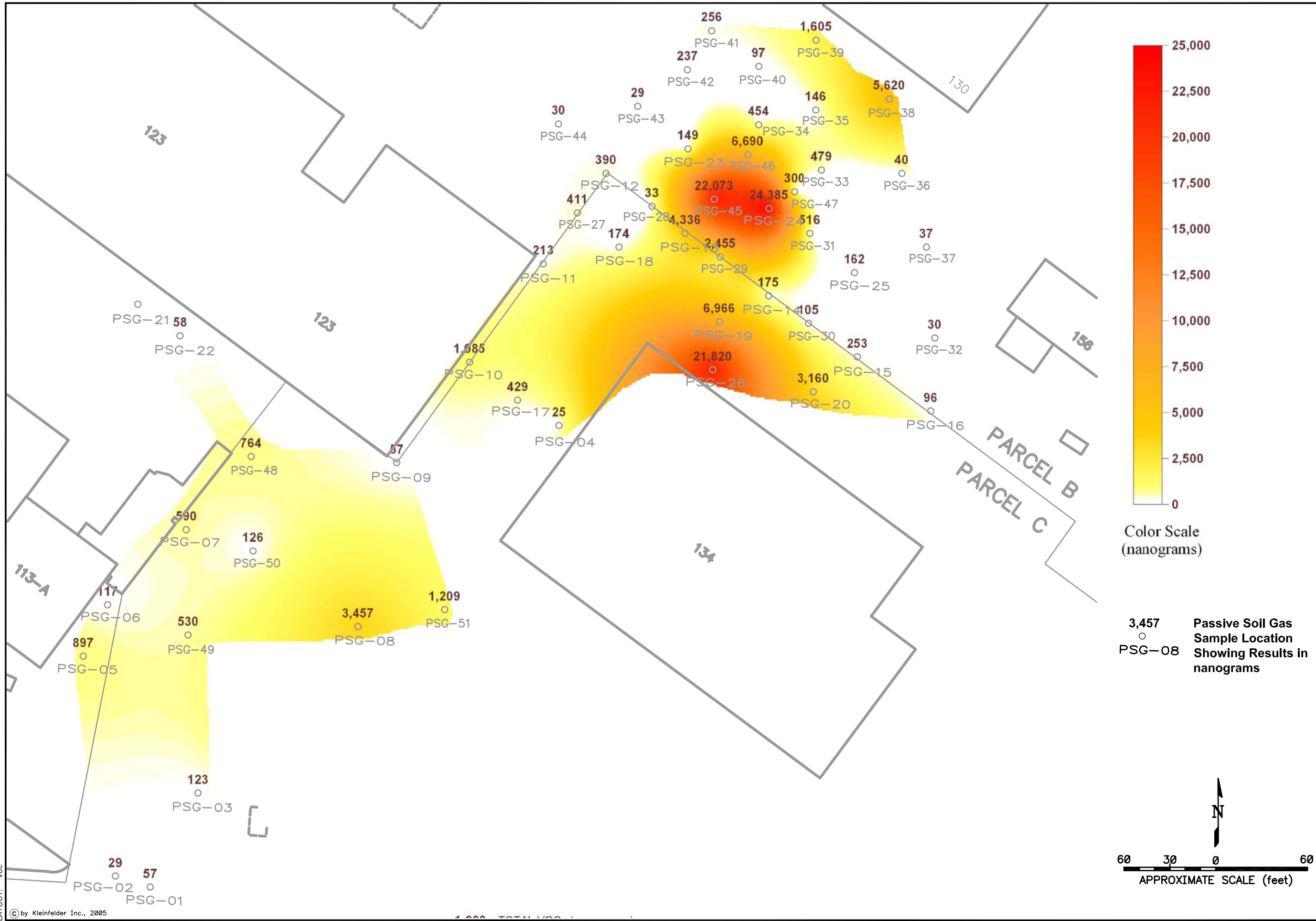
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4,000 TOTAL VOCs



FIGURE

DISTRIBUTION OF TOTAL VOCs IN PASSIVE SOIL GAS,
AUGUST-SEPTEMBER 2005

FINAL SAP FOR CONTAMINATION DELINEATION AT RU-C5, NOVEMBER 2005
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A-11



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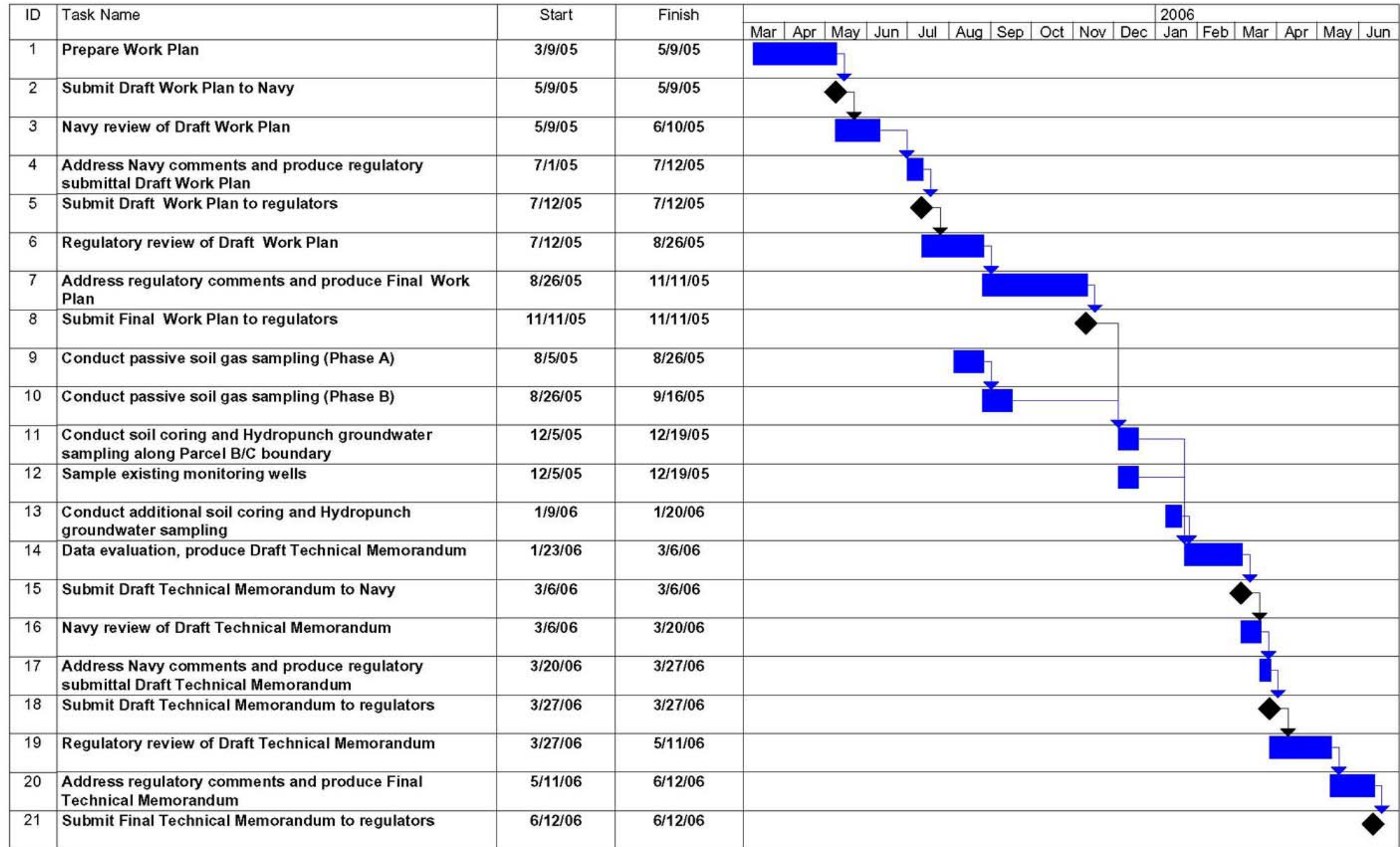
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Task



Milestone



FIGURE

A-12

PROJECT SCHEDULE

FINAL SAP FOR CONTAMINATION DELINEATION AT RU-C5, NOVEMBER 2005
Hunters Point Shipyard, San Francisco, California
U.S. Navy, NFECSW, San Diego, California

PROJECT NO. 19000-021

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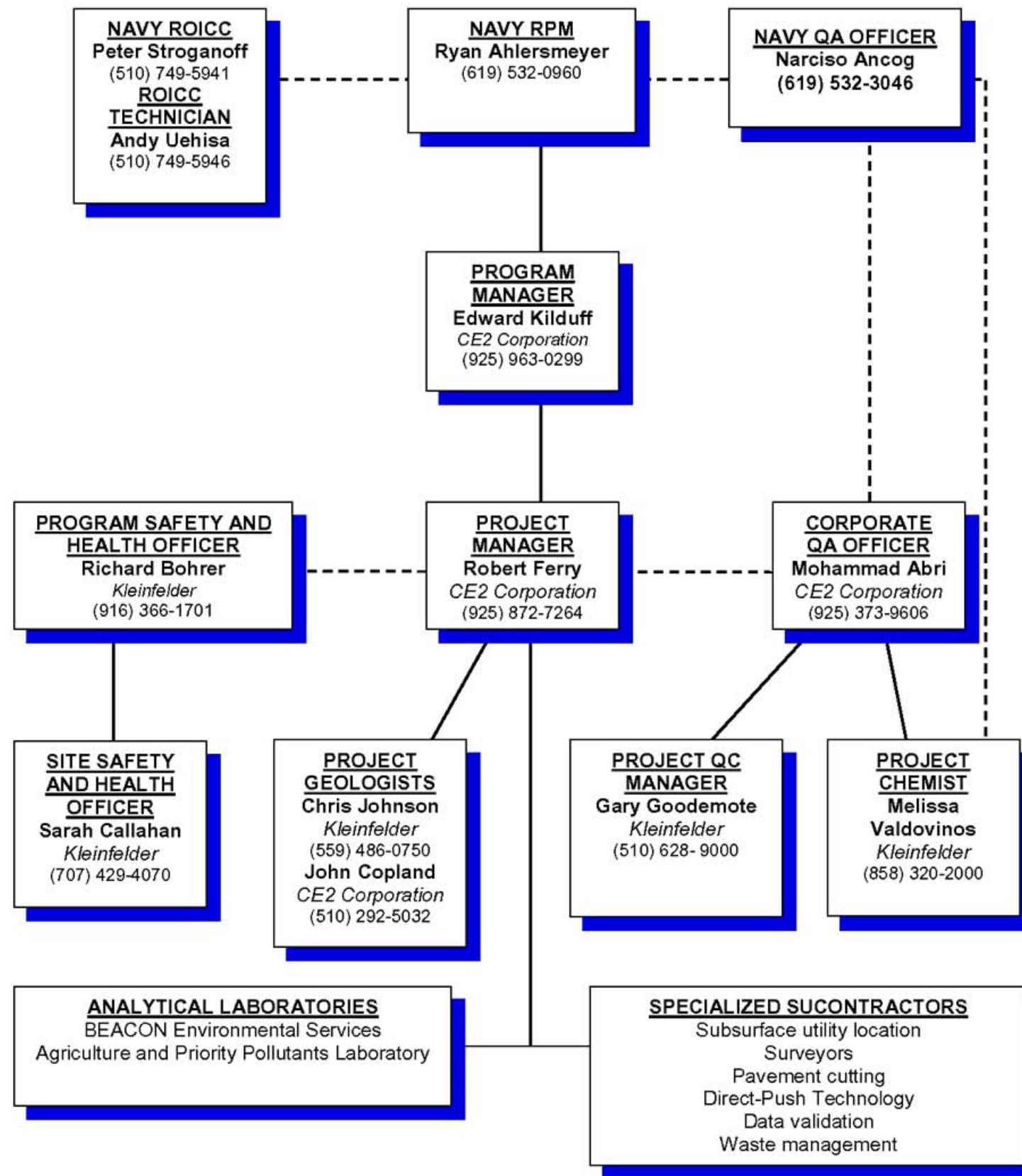
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LAYOUT: Layout1



— Lines of authority
- - - Lines of communication

QA Quality Assurance
QC Quality Control
ROICC Resident Officer in Charge of Construction
RPM Remedial Project Manager

FIGURE

A-13

ORGANIZATIONAL CHART

FINAL SAP FOR CONTAMINATION DELINEATION AT RU-C5, NOVEMBER 2005
Hunters Point Shipyard, San Francisco, California
U.S. Navy, NFECSW, San Diego, California

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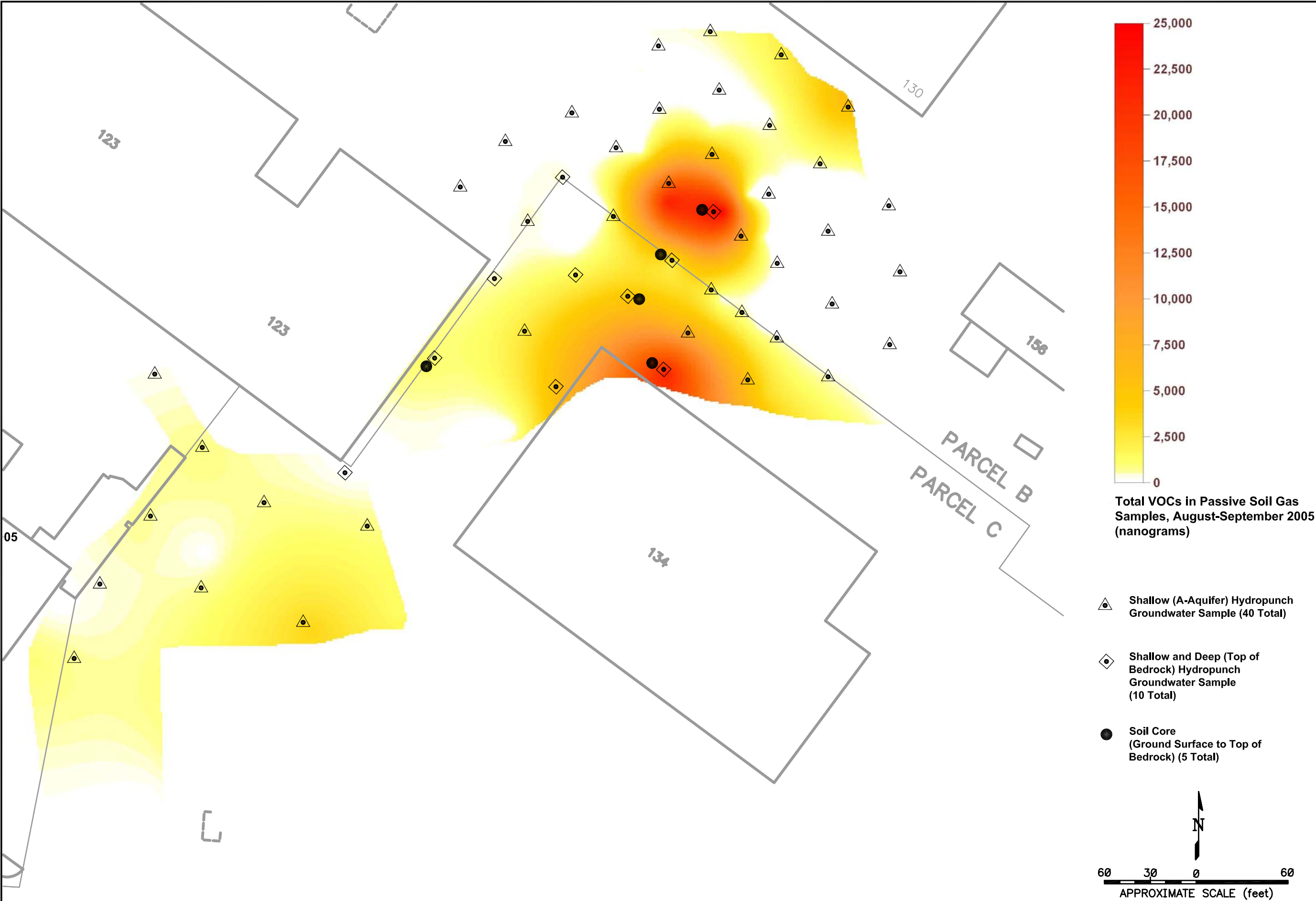
DATE: 11/01/05



ATTACHED IMAGES: BEACON 112_Trichlorotrifluoroethane.jpg Images: BEACON TCE.jpg Images: BEACON Total VOCs.jpg Images: BEACON Total VOCs _only.jpg Images: BEACON Trichloro
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DRAWN BY: L. Sue DATE: 11/01/05	CHECKED BY: S. Quayle REVISED:	FINAL SAP FOR CONTAMINATION DELINEATION AT RU-C5, NOVEMBER 2005 Hunters Point Shipyard, San Francisco, California U.S. Navy, NFECSW, San Diego, California	A-14
		PROJECT NO. 19000-021	

Contract N68711-05-C-6406

Appendix B:

Final Site-Specific Safety and Health Plan for Contamination Delineation at Remedial Unit C5

**Hunters Point Shipyard
San Francisco, California**

**November 2005
Revision 0**

Prepared for:



Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Franzee Road, Suite 900
San Diego, California 92109

Prepared by:



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Pleasanton, CA 94588-3655
(925) 463-7301



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Oakland, CA 94612
(510) 628- 9000

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Acronyms and Abbreviations

$\mu\text{g}/\text{m}^3$	Micrograms per Cubic Meter
ACGIH	American Conference of Governmental Industrial Hygienists
ACOE	Army Corps of Engineers
AHA	Activity Hazard Analysis
BTEX	Benzene, Toluene, Ethyl Benzene, and Xylenes
Cal-OSHA	California OSHA
CAS	Chemical Abstract System
CCR	California Code of Regulations
CE2	CE2 Corporation
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CNS	Central Nervous System
CPR	Cardiopulmonary Resuscitation
CRZ	Contamination Reduction Zone
dBA	Decibels of Acoustic Energy
DCA	Dichloroethane
DCE	Dichloroethene
DCP	Dichloropropane
DPT	Direct-Push Technology
FID	Flame Ionization Detector
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High-Efficient Particulate Air
HPS	Hunters Point Shipyard
IDLH	Immediately Dangerous to Life and Health
IR	Installation Restoration (Program)
LEL	Lower Explosive Limit
N/A	Not Applicable
NIOSH	National Institute of Safety and Health
OSHA	Occupational Safety and Health Administration
OVA	Organic Vapor Analyzer
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethylene
PEL	Permissible Exposure Limit
PID	Photoionization Detector
PNA	Polynuclear Aromatic Hydrocarbon
PPE	Personal Protective Equipment
ppm	Parts per Million
RU	Remedial Unit
SAP	Sampling and Analysis Plan
SSHO	Site Safety and Health Officer
SSHP	Site-Specific Safety and Health Plan
STEL	Short-Term Exposure Limit
TCE	Trichloroethene
TLV	Threshold Limit Values

Acronyms and Abbreviations

TWA	Time Weighted Average
UEL	Upper Explosive Limit
VOC	Volatile Organic Compound
WP	Work Plan

1.0 Introduction

This Site-Specific Safety and Health Plan (SSHP) has been developed to protect and guide the personnel conducting field activities at Remedial Unit (RU) C5 at Hunters Point Shipyard (HPS), San Francisco, California conducted under Navy Contract N68711-05-C-6406. The provisions of this SSHP apply to employees of CE2 Corporation (CE2), its subcontractor Kleinfelder, Inc., (Kleinfelder), and other subcontractors to be determined. Employees of Federal, State, and Local agencies, the client, and client-retained subcontractors are expected to observe the safety rules and regulations established by their respective organizations in addition to the requirements of this document. This SSHP is intended to provide site-specific safety and health awareness for the contamination delineation to be conducted at RU-C5. The SSHP has been prepared to meet applicable requirements of the United States Army Corps of Engineers (ACOE) Safety and Health Requirements Manual EM 385-1-1 (ACOE, 2003), the Code of Federal Regulations, 29 CFR 1910.1200 Hazard Communication Standard, and CE2 and Kleinfelder Safety and Health policies.

1.1 Project Location and Description

HPS is located in southeast San Francisco on a promontory that extends east into the San Francisco Bay. The U.S. Navy controls approximately 848 acres in Parcels B, C, D, E, E2, and F (underwater). Former Parcel A (88 acres) was transferred to the City and County of San Francisco in 2004.

1.2 Background

HPS was operated as a commercial drydock facility from 1869 until 1939. In 1940, the Navy obtained ownership of the shipyard for ship building, repair, and maintenance activities. After World War II, activities shifted from ship repair to submarine servicing and testing. HPS was deactivated in 1974 and remained relatively unused until 1976. Between 1976 and 1986, the Navy leased most of the property to a privately owned ship repair firm. In 1986, the Navy again occupied the shipyard and began a program to investigate and clean up contamination resulting from past activities.

In 1989, the U.S. EPA placed HPS on the National Priorities List. Shipyard activities generated a variety of inorganic and organic wastes. The Installation Restoration Program cleans up past disposal sites at HPS. HPS was identified for closure during the Base Realignment and Closure process of 1991.

RU-C5 is located near Building 134 in the northern portion of Parcel C in Installation Restoration (IR)-25 and IR-06. In the past, Building 134 was used for offices, machine shops, repair shops, a laboratory, and storage. The two primary sources of contamination at RU-C5 include: (1) the sump and dip tank in Building 134 and the former fuel tank farm area in IR-06. A soil vapor extraction system in Building 134 was operated for approximately 5 months in 2001. Other remedial actions include excavating the sump and dip tank and a bioremediation study. Aboveground storage tanks and pumphouse buildings were removed in 1993. Excavations and removal of fuel lines were completed under the Parcel B remedial action from 1998 to 2001.

1.3 Project and Site-Specific Safety and Health Plan Objectives

The primary objective is to collect additional site characterization data to further delineate the horizontal and vertical extent of VOC contamination at RU-C5 along the boundary between Parcels B and C.

This SSHP identifies hazards and risks associated with the planned field activities and provides guidance to field personnel for managing and avoiding potential consequences from those risks and hazards.

1.4 Scope of Work

The proposed field tasks are to conduct:

- Passive soil gas sampling by drilling a 1-inch diameter hole to a depth of 2 ft or less, placing the sampler in the hole, covering the hole with a thin layer of grout, and retrieving the sampler in approximately one week,
- Soil coring using DPT (non-rotary),
- Hydropunch[®] groundwater sampling using DPT, and
- Groundwater sampling from existing monitoring wells.

1.5 Schedule

The passive soil gas sampling was performed in the summer of 2005, and the remaining activities will occur in the fall of 2005. The project schedule is presented is provided in the Sampling and Analysis Plan (SAP).

2.0 Administrative Requirements

2.1 Personnel

Personnel responsible for project safety include the Program Safety and Health Officer, Project Manager, the Site Safety and Health Officer (SSHO), and participating project personnel. A list of project contacts is provided as Table A-1 in the SAP.

2.1.1 Program Safety and Health Officer

The Program Safety and Health Officer reviews and approves the SSHP. The Program Safety and Health Officer will be called upon to assist the Project Manager and SSHO with issues pertaining to the SSHP.

2.1.2 Project Manager

The Project Manager has ultimate authority and responsibility for project Safety and Health. Accordingly, the Project Manager has the authority and responsibility to audit compliance with the provisions of this SSHP, suspend work or modify work practices for safety and health reasons, and to dismiss individuals from a site whose onsite conduct does not comply with the provisions of the SSHP and/or endangers the safety and/or health of others. The Project Manager is responsible for distributing the plans to field personnel and to an authorized representative of each firm that has a subcontract with CE2 to conduct onsite work. The Project Manager is also responsible for implementing the provisions of the SSHP and any applicable addenda. Implementation includes:

- Review of the SSHP requirements,
- Review of the provisions of the plan with field personnel involved with the project,
- Provisions for safety equipment,
- Submittal of the requisite safety and health documentation (training rosters, site personnel logs, medical releases) to the SSHO, and
- Designation/identification of a project member as the SSHO.

2.1.3 Site Safety and Health Officer

The SSHO is responsible for assisting the Project Manager with onsite implementation of the SSHP. The responsibilities of the SSHO include:

- Maintaining safety equipment supplies,
- Performing air quality measurements and monitoring,
- Enforcing compliance with air quality monitoring action levels,
- Directing decontamination operations,
- Directing emergency response operations until public emergency personnel arrive onsite,
- Setting up work zone limits, and

- Reporting all accidents, incidents, and infractions of safety rules and requirements to the Project Manager.

The SSHO has the authority to suspend work any time the SSHO judges that the provisions of the SSHP are inadequate to provide a working environment conducive to worker safety. Further, the SSHO is to inform the Project Manager of any individuals whose onsite presence jeopardizes safety and health.

2.1.4 Project Field Staff

All onsite project personnel are responsible for complying with the provisions of this SSHP, performing work in a manner that is conducive to good worker safety and health, and reading and being knowledgeable of this SSHP.

2.2 Personnel Training

2.2.1 Site Workers

Employees who would be considered general or occasional site workers under the federal Occupational Safety and Health Administration (federal OSHA) Code of Federal Regulations (29 CFR 1910.120) or California OSHA (Cal-OSHA) California Code of Regulations (Title 8 CCR 5192) will be currently certified in Hazardous Waste Operations and Emergency Response (HAZWOPER), including annual refresher training.

2.2.2 Supervisors and Managers

Employees who would be considered supervisors and managers under the federal-OSHA 29 CFR 1910.120 or Cal-OSHA Title 8 CCR 5192 will be currently HAZWOPER Supervisor certified. In addition, the supervisors and managers will have a certified First Aid and CPR-trained employee on the site during field activities.

2.2.3 Project Orientation

In addition to the HAZWOPER certification, site workers will attend a project orientation. The orientation will include training on Activity Hazard Analyses and all elements of the SSHP.

2.2.4 Daily Safety Meeting

During the active field components of the project, the SSHO or designee will conduct daily safety meetings prior to beginning field work. These meetings will include information on the following subjects, as applicable:

- Review of safe work practices,
- Review of Activity Hazard Analyses,
- Feedback from employees on hazards, safety suggestions, or concerns, and
- Recognition for compliance, good safety performance, or attitude.

Attendance at the daily safety meeting is considered a part of each employee's job duties, and will be documented on a sign-in sheet by the SSHO or designee.

2.3 Medical Surveillance

Employees considered general site workers under the federal-OSHA 29 CFR 1910.120 or Cal-OSHA Title 8 CCR 5192 will be included in the Company's medical surveillance program. CE2 and subcontractor employees will supply a consulting physician with personal exposure information. Annual physicals will be required of those employees who spend more than 30 hours per month in Exclusion Zones in any given month over a one-year period. Otherwise physicals will be required on a biannual basis.

At minimum, project personnel who will be involved with onsite field activities are advised to be in excellent physical condition and free of cardio-pulmonary impairment. As an extension of the above requirement, workers wearing respiratory protective equipment during this project will, first, be examined by an occupational physician and be proclaimed to be in good health prior to the use of such equipment. As part of this examination, the physician should evaluate the examinee's ability to use negative-pressure respirators. Personnel diagnosed as either unfit or unable to utilize a respirator, or as having medical conditions which could directly or indirectly be aggravated by either exposure to dusts, particulates, petroleum hydrocarbon vapors, solvent vapors, or by the use of personal protective equipment (PPE), will not be allowed to participate in field activities.

In addition, personnel with illnesses or injuries involving open wounds may not be allowed onsite. Field personnel that develop a potentially work-related illness or injury during the project should be examined by a physician. The physician must assess that the employee is fit to return to work before they can continue to participate in the field activities onsite.

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3.0 Hazard Analysis

The following hazards were assessed to either exist, or have the potential to develop, during the performance of the project activities:

Mechanical

- Type(s)/Source: DPT, installation of passive soil gas samplers.
- Qualified Exposure Risk: Moderate.
- Primary Control: Housekeeping and awareness, hard hat, safety glasses, gloves, steel-toed shoes, safety vest.

Utility/Electric

- Type(s)/Source: DPT.
- Qualified Exposure Risk: Moderate.
- Primary Control: USA DIG-ALERT and utility survey.

Acoustical

- Type(s)/Source: DPT, general industrial surroundings.
- Qualified Exposure Risk: Low.
- Primary Control: Hearing protection.

Biological

- Type(s)/Source: Germs/bacteria, fecal matter in some places.
- Qualified Exposure Risk: Moderate.
- Primary Control: Personal hygiene, PPE.

Thermal

- Type(s)/Source: Fuels, petroleum vapors, solvents.
- Qualified Exposure Risk: Moderate.
- Primary Control: Flammable storage lockers, segregation, lower explosive limit (LEL) monitoring.

Chemical

- Type(s)/Source: Hydrocarbons, metals, fuels, pesticides.
- Target Organ(s): Central nervous system, liver, skin.
- Anticipated Physiologic Response: Nausea, dizziness, headaches.
- Qualified Exposure Risk: Moderate.

- Primary Control: Air monitoring, PPE.

Activity Hazard Analyses for this project are:

- Passive soil gas sampling (Attachment B-1),
- DPT, (Attachment B-2), and
- Groundwater sampling from existing monitoring wells (Attachment B-3).

3.1 Mechanical Hazards

3.1.1 Material Handling/Back Injury

An estimated 28% of industrial workers will experience disabling lower back pain or injury in the course of their careers. The factors that lead to these injuries are more chronic than acute, and include: routine lifting or one-time-only lifting; the weight of the object; the frequency of lifting; bending, twisting, or rotating during lifting; prolonged sitting; exposure to vibrations; poor arch support in shoes; and, not stretching prior to physical activity.

All hand tools will be secured and care will be taken when entering areas where work is being performed above eye level. Before attempting to lift and carry an object, always test the weight, first. If it is too heavy, get help. If possible, use mechanical lifting aids. If manageable, the proper method for lifting is:

- Get a good footing,
- Place feet about shoulder width apart,
- Bend knees to pick up load. Never bend from the waist,
- Keep back straight,
- Get a firm hold. Grasp opposite corners of the load, if possible,
- Keep the back as upright as possible,
- Lift gradually by straightening the legs,
- Keep the weight as close to the body as possible, and
- When changing directions turn the entire body, including the feet. Don't twist the body.

If devices are used for handling materials manually (e.g., two-handed lifters, barrel ring clamps, hand trucks, wheelbarrows), workers should wear protective equipment (e.g., gloves and safety shoes) to minimize the potential for those appendages to become pinched or smashed between the load and stationary features. Avoid overloading the device.

3.1.2 Striking Injuries

Injuries often result when a worker unexpectedly contacts an object. These occurrences typically result from inadvertent slips, trips, and falls.

Personnel will maintain a constant program of good housekeeping and keeping work areas clear of trip hazards and slippery surfaces. In cases where personnel are required to work more than six feet above a work surface or platform, extra precautions will be taken if guardrails or railings are absent. The precautions will include the use of either an emergency or working safety harness with lanyard or lifeline.

3.1.3 Struck-by Injuries

Injuries often result when a worker becomes an unexpected receptor of contact with an object. These occurrences typically result from the worker being struck by a dropped or collapsed mass or a moving piece of equipment or vehicle.

3.1.3.1 Heavy Equipment Operation

Heavy equipment and vehicles will be equipped with a backup alarm to warn workers that the vehicles are moving in reverse. Personnel working in proximity to operating equipment will maintain a high degree of awareness and remain out of harms way of the moving portions of the equipment. In addition, personnel will refrain from wearing loose jewelry or clothing, especially when in proximity to rotating tools. Personnel working on foot in proximity to moving equipment will wear orange safety vests and hard hats.

3.1.3.2 Compressed Gas

Caution must be exercised when compressed gas cylinders are being handled or recharged. When a cylinder is not in use, the cap must be in place and the cylinder secured. If the cylinder is in use, or if the cap is not in place, the cylinder must be chained upright or placed in a horizontal position so that it cannot fall and break the valve. If placed horizontally, the cylinders must be blocked to prevent rolling.

3.1.3.3 General

Lockout, blocking, or equivalent measures will be employed to ensure that deactivated systems and equipment are not inadvertently reactivated.

Hazards with machines and heavy equipment are created when there are rotating, reciprocating, and transverse motions, or cutting, punching, shearing, and bending actions. The following methods of guarding will be used on this project:

- Fixed enclosures (the preferred method). They prevent access to dangerous parts by enclosing the hazardous operation with barriers.
- Interlocking devices. These automatically stop a machine if a barrier is removed or a door to the operating parts is opened. The device may also be in the form of a barrier that quickly stops the machine when any part of the operator's body contacts the barrier. The barrier may be a bar, a rod, a wire, or an electric-eye beam extended across the danger zone.

Adequate illumination intensity will be provided in all active work areas as outlined in 29 CFR

1926.56. A meter to establish illumination values in foot candles can be rented from safety supply companies. Table B-1 summarizes the illumination requirements of 29 CFR 1926.56.

3.2 Electrical/Utility Hazards

Contact with electrical current can cause shock, electrical burns, and can be instantly fatal. The potential for exposure to electrical current exists through contact with electrical tools or equipment, generators, electrical control equipment, and overhead and underground power lines. Care must be taken to avoid contact with sources of electricity.

If a piece of equipment (e.g., drill rig) makes contact with electrical wires, it may or may not be insulated from the ground by the tires of the carrier. Under either circumstance the human body, if it simultaneously comes in contact with the drill rig and the ground, will provide a conductor of the electricity to the ground. Death or serious injury can be the result.

If equipment makes contact with overhead or underground electrical lines:

- Under most circumstances, the operator and other personnel on the seat of the equipment should remain seated and not leave the equipment. Do not move or touch any part, particularly a metallic part, of the equipment.
- If it is determined that the equipment should be vacated, all personnel should jump clear and as far as possible from the equipment. Do not step off, and do not hang on to the equipment or any part of the equipment when jumping clear.
- If you are on the ground, stay away from the equipment, do not let others get near the equipment, and seek assistance from local emergency personnel such as the police or a fire department.
- When an individual is injured and in contact with energized equipment or power lines, rescues should only be attempted with extreme caution. If a rescue is attempted, use a long, dry, unpainted piece of wood or a long, dry, clean rope. Keep as far away from the victim as possible and do not touch the victim until he is completely clear of the drill rig or electrical lines.
- When the victim is completely clear of the electrical source and is unconscious and a heartbeat (pulse) cannot be detected, begin cardiopulmonary resuscitation (CPR) immediately and contact emergency response personnel.

3.2.1 Underground Utilities

Before performing DPT work, USA Dig-Alert (1-800-227-2600) will be contacted and as-built plans will be reviewed. A subcontracted utility locator will supplement USA Dig-Alert's demarcations. Work will not proceed until locating activities have been completed and documented in the site records. The safety orientation meeting for onsite field personnel will include: (1) reviewing of a map of known or suspected underground utilities, and (2) conducting a site walkover to familiarize personnel with the locations of known or suspected utilities. In areas where the presence of underground utilities is known or suspected, a hand auger will be advanced a minimum of 5 feet below ground surface prior to powered drilling operations. The selection of locations or

areas where hand augering is not required will be approved by the Navy.

Utility clearance and hand auguring is not required for the installation of the passive soil gas samplers because the holes drilled to place the samplers will be 2 ft or less.

If personnel encounter a subsurface condition where previously unidentified underground utilities are suspected: (1) work will cease, (2) equipment will be secured, and (3) the Project Manager and Site Safety and Health Officer (SSHO) will be notified.

3.2.2 Overhead Power Lines

Operation of equipment in the vicinity of overhead power lines will be in accordance with Cal-OSHA Electrical Safety Orders. The subcontractor's field supervisors and operators will take necessary precautions for implementing safe work practices under such conditions. The general clearances required from energized overhead high-voltage conductors for drilling rigs are:

Nominal Voltage (phase to phase)	Minimum Required Clearance (feet)
600-50,000	6
over 50,000-345,000	10
over 345,000-750,000	16
over 750,000-1,000,000	20

3.3 Noise Hazards

Exposure to high levels of noise, both chronic and acute, can lead to different types of reactions. Acute (impulse) noise, such as noise associated with heavy equipment operation, jack hammers, drilling activities, and work performed in the flight path of aircraft can afflict the operator with a temporary loss of hearing at certain frequencies associated with the equipment being used. However, chronic exposure to this noise may eventually cause the hearing acuteness to be permanently and irreversibly changed. The change may be subtle and occur over a period of time.

Permanent noise-induced hearing loss is attributed to the intensity and frequency distribution of the noise, the time pattern and duration of exposure, and individual susceptibility. Sound levels (noise) are measured in decibels (dBAs). The Threshold Limit Values (TLV) for noise exposure is 85 dBA for an 8-hour duration and 90 dBA for a 4-hour duration. It is not expected that the noise level generated during most fieldwork will exceed the TLV.

Ordinarily, acute hearing loss is reversible when removed from the exposure. After a short period of time (less than a day), the hearing generally returns to normal. Earplugs should be available onsite for hearing protection. If an employee feels it is necessary to shout to be heard at a distance of three feet, then hearing protection such as earplugs or earmuffs or muffled equipment must be used.

3.4 Biological Hazards

3.4.1 Poisonous Plants, Insects, and Animals

Contact with plants, insects, and animals present at a site should be avoided. Plants such as poison oak may be present at a site and can cause an allergic reaction and skin rash in some individuals. Specially prepared cream barriers, such as Teknu[®], for protection against poison oak are commercially available and may minimize the potential for development of skin rash due to exposure to poison oak. Stinging and biting insects including bees, spiders, and ticks may be present. Insect repellent may be used to discourage insect contact with skin.

Poisonous animals such as snakes may be present at a site. Before beginning field work each day, observe the work area for the potential presence of inhabitant reptiles and take measures necessary to minimize the potential for contact.

The primary concern with animal bites and scratches is the potential for infection and/or rabies. Although the disease rabies can be fatal, it takes a few days to develop. Be sure a victim obtains medical attention quickly if an animal bite or scratch occurs. In the meantime, scrub the wound with soap and water, and rinse thoroughly under running water. Dry off and place a clean bandage on the wound.

Insect bites are generally not dangerous unless they are from a poisonous insect. Snake or scorpion bites can also be dangerous, but more from infection or trauma than the toxins injected by the snake or scorpion. Victims of these bites should lie down and remain motionless; cold packs should be applied and medical attention sought immediately. If you are allergic to bee or wasp stings and you are stung, seek immediate medical attention.

All snakebites should initially be treated as if they are poisonous. The effects of poisonous bites depend on the size of the victim, location of the bite and the amount of venom injected. The victim should be transported to receive immediate medical attention.

3.4.2 Blood-born Pathogens

Disease transmission occurs when bacteria or viruses from one person enter the body of another person. In the event of an accident at a site where a victim is bleeding, assume that the potential for infectious disease is present. If contact is made with the victim's blood and a sore, cut, scrape, or scab is present, a path exists for infection to enter the body. Action to control bleeding is important to prevent infectious disease transmission as well. A properly equipped First Aid kit will contain barriers and antiseptics to wash hands before and after treating a bleeding victim, as a minimum of protection.

To further reduce the risk of transmission:

- Avoid being splashed by blood,
- Place a barrier between you and the victim's blood by wearing disposable gloves and covering the wound with a dressing or plastic wrap,

- Cover any cuts or scrapes or skin conditions you have,
- Wash your hands immediately after providing care, even if you wore gloves,
- Avoid eating, drinking, or touching your mouth, eyes, or nose while providing care before you wash your hands, and
- Avoid handling your personal items (comb, pen, knife) until you wash your hands.

These steps are precautions to reduce the risk of disease transmission. Your primary goal is to care for the victim, but providing protection from disease transmission is critical for both you and the victim.

3.4.3 Infectious Disease (Hanta virus)

Hanta virus is a potentially lethal disease carried by the feces and urine of specific rodents that attacks pulmonary function (lung performance). Contact is most likely to occur when personnel open and work in control boxes, wellheads, and remediation equipment that are located in rural areas and have rodents potentially nesting in the equipment or support trailers. The dried feces and urine can be carried by dust and inhaled.

The best protection for Hanta virus is to maintain good housekeeping at field sites. Secondly, wet an area down if there is dust. This allow easier cleanup without the risk of dust inhalation.

3.5 Thermal Hazards

3.5.1 Heat Stress

Heat stress occurs when the body produces or absorbs more heat than it is able to dissipate. Heat is produced internally as the result of metabolic activity and increases with body activity or the level of physical work being performed. Heat can be absorbed by the body from ambient air and from the radiant heat of the sun.

The body's ability to absorb heat is therefore affected by factors such as the ambient air temperature and humidity, air density, radiant energy, and cloud cover, wind velocity and air flow, and localized heat generation, such as that from power equipment.

The body's ability to dissipate heat to the environment is dependent on factors such as the amount of heat and radiant energy in the ambient environment, exposure to the ambient or radiant heat in that environment, and its own inherent ability to cool itself (perspiration).

Exposure to ambient conditions is affected by such factors as wind velocity or airflow, cloud cover or shade, and the type of protective clothing being worn. Table B-2 shows the temperature equivalents for permeable and impermeable work clothing.

Any of these factors may contribute to a loss of body fluids and electrolytes and an increase in body temperature. A significant increase in body temperature can be life threatening and rapidly become fatal or result in permanent injury. Heat stress may cause any of the following conditions: heat cramps, heat syncope, heat exhaustion, and/or heat stroke.

3.5.2 Heat Cramps

Heat cramps are caused by perspiration that is not balanced by adequate fluid and electrolyte intake. Heat cramps are often the first sign of a condition that may lead to heat stroke. Symptoms include acute painful spasms of voluntary muscles (e.g., abdomen and extremities).

For treatment, remove victim to a cool area and loosen clothing. Have victim drink 1-2 cups of water (preferably supplemented with an electrolyte solution such as Gatorade™) immediately and every 20 minutes thereafter until symptoms subside. Total water consumption should be 1-2 gallons per day. Consult with a physician.

3.5.3 Heat Syncope (Unconsciousness)

Syncope or sudden loss of consciousness may be a consequence of heat illness, particularly when the worker stands relatively still in a hot environment. Although the worker may be slightly disoriented immediately after he regains consciousness, alterations of the mental state (confusion, delirium, disorientation) or prolonged unconsciousness (i.e., a few minutes) are not parts of this syndrome. The possibility of heat stroke must always be considered when a worker loses consciousness.

3.5.4 Heat Exhaustion

Heat exhaustion is a state of very definite weakness or exhaustion caused by the loss of fluids from the body. This condition is much less dangerous than heat stroke but it must still be treated. Symptoms include pale, clammy, moist skin, profuse perspiration and extreme weakness. Body temperature is normal, pulse is weak and rapid, and breathing is shallow. The victim may have a headache, may vomit, and may be dizzy.

For treatment, remove victim to a cool area and loosen clothing, place in a head-low position, and provide bed-rest. Consult with a physician, especially in severe cases. The normal thirst mechanism is not functioning so have victim drink 1-2 cups of water (preferably supplemented with an electrolyte solution such as Gatorade™) immediately and every 20 minutes thereafter until symptoms subside. Total water consumption should be 1-2 gallons per day.

3.5.5 Heat Stroke

Heat stroke is an acute and dangerous reaction to heat stress caused by a failure of the heat-regulating mechanisms of the body (i.e., sweating stops). The body temperature rises so high that brain damage and death may result if the victim is not cooled quickly.

Symptoms include red, hot, dry skin, although a person may have been perspiring earlier; nausea; dizziness; confusion; extremely high body temperature; rapid breathing and pulse; unconsciousness or coma.

For treatment, cool the victim quickly. If the body temperature is not brought down quickly, permanent brain damage or death will result. Soak the victim in cool but not cold water; sponge the body with cool water; pour water on the victim's body to get the body temperature to a safe level

(102°F). Observe the victim and obtain medical help. Do not give the victim tea, coffee, or alcoholic beverages. In hot conditions, more frequent rest and fluid-intake is required. Institute a work/rest program.

3.5.6 Fires and Explosions

The two primary methods of preventing thermal injury from fire or explosions are to prevent their occurrence or, if they should happen, to be at a safe distance away.

To prevent or control the risk of fire or explosion, the preferred method involves recognizing the hazard and taking appropriate steps. This includes using equipment to detect an explosive or flammable atmosphere (e.g., explosimeter with a 10% LEL action level) and using equipment that will not ignite flammable gases or vapors (e.g., intrinsically safe instruments, non-sparking brass, bronze, or aluminum tools).

In areas where flammable liquids are stored, handled, used, dispensed, or transferred, smoking and the carrying of lighters, matches, and other spark-producing devices should be prohibited. A spark generated by static electricity can have sufficient energy to ignite flammable or explosive gases, vapors, or dusts. Static electricity is generated by the contact and separation of dissimilar material and can occur between two charged bodies even if there is no good electrical conductive path between them.

Static electricity can be prevented from causing a spark during flammable liquid transfer by bonding and grounding. Bonding is the linking of two containers by an electrical connection. Grounding eliminates a difference in electrical potential between a container and the earth. For bonding and grounding to be effective, both containers must be metal and at least one container must be grounded. It is important that clamps or clips make a good metal-to-metal contact and are not blocked by a non-conductive material such as paint.

3.6 Chemical Hazards

3.6.1 Gasoline

Gasoline is a complex blend of petroleum hydrocarbons primarily composed of paraffins, naphthenes, aromatics, and olefins. It is a colorless to red liquid with a petroleum odor. It is a flammable liquid with a high volatility and its vapors are heavier than air. Exposure thresholds are shown in Table B-3.

Under conditions where exposure occurs, eye, nose, and throat irritation, headache, nausea, drowsiness, and dizziness may possibly occur. In open areas, ventilation is usually adequate to minimize prolonged breathing of high gasoline vapor concentrations. Gasoline containing benzene, toluene, ethyl benzene, and xylenes (BTEX) may be potentially carcinogenic in laboratory animals. A hazard assessment of these compounds follows the gasoline assessment.

When certain proportions of a combustible vapor are mixed with air and a source of ignition is present, an explosion can occur. The range of concentrations within which this will occur with gasoline is 1.3 percent to 8 percent. Therefore, under normal conditions, the lowest percentage of

the material in the air in which an explosion will occur is the LEL or 1.3 percent and the highest percentage of the material in the air in which an explosion will occur is the upper explosive limit (UEL) or 8 percent. Gasoline has a flash point of -45°C or -49°F. Extreme caution must be taken to prevent sources of ignition from coming into contact with gasoline vapors. A 25-foot no smoking zone (also referred to as restricted access work zone) must be maintained during work hours.

3.6.2 Aromatic Petroleum Distillates

Exposure thresholds for petroleum distillates are shown in Table B-4. Benzene is found in varying concentrations in gasoline. It is a colorless liquid with strong aromatic petroleum hydrocarbon-like odors. Benzene is flammable compound and is moderately volatile. Exposure to benzene may cause irritation to the eyes, skin, and nose, damage to the respiratory system, staggered gait, headaches, fatigue, lassitude, dermatitis, anorexia, and nausea. Benzene is a known human carcinogen and has been shown to cause leukemia, blood disorders and chromosome damage in humans and adverse birth effects in laboratory animals.

1,2-Dichlorobenzene is a colorless liquid. Used as a solvent for waxes, gums, resins, tars, as an insecticide, and as an intermediate in the manufacture of dyes. It has a pleasant aromatic odor. Vapors are irritating to eyes, nose, and throat. It irritates eyes, nose, and liver, can cause kidney damage, skin damage in the form of blisters.

1,4-Dichlorobenzene is a solid white to crystalline solid at room temperatures. It is used as a moth killer, in space deodorizers, in the manufacture of some resins, and as an insecticide. Upon exposure to air, it transforms from solid state into a vapor. It is very insoluble in water. Exposure can damage the kidneys, liver, lungs, and blood cells, cause swelling, nervous system damage. Prolonged exposure at these concentrations may result in nausea, headaches, clumsiness, and dizziness. Symptoms may include swelling of the hands, eyes, and feet; weakness, trembling, and numbness of the arms and legs; itching and skin rash.

If exposure to any of these compounds occurs, wash the affected area with soap and water and seek medical attention immediately.

3.6.3 Diesel Fuel

Diesel fuel is a complex combination of petroleum hydrocarbons produced by the distillation of crude oil. It is a colorless to light amber colored liquid with a petroleum hydrocarbon-like odor. Its vapors are heavier than air and it is insoluble in water. Exposure thresholds are shown in Table B-5.

Because of its low volatility, exposure to diesel fuel by inhalation is unlikely. Under conditions where exposure may occur, eye, nose, and throat irritation, headache, nausea, drowsiness, and dizziness are the only potential effects. This material is a skin irritant and repeated exposure to similarly refined and processed petroleum-based materials has been shown to cause skin cancer in laboratory animals. There is no known evidence that this material causes skin cancer in humans.

3.6.4 Used Waste Oils

Used waste oils are typically mixtures of used lubricating, hydraulic, and compressor oils. They

also contain combustion products, which may contain active polynuclear aromatic hydrocarbons (PNAs) and should be treated as a carcinogen and inhalation of their vapors should be avoided. As such, they are complex mixtures of middle to heavy petroleum-based hydrocarbons. Acute toxicity associated with exposure to this material is low. Some degree of skin irritation is possible with prolonged contact. Exposure thresholds are shown in Table B-6.

Chronic exposure to some lubricating base stocks (oils) and used crankcase oils have been shown to cause skin cancer in laboratory animals.

3.6.5 Polychlorinated Biphenyls

PCBs have been classified by the National Institute of Safety and Health (NIOSH) as being of low acute toxicity, but it has been demonstrated that they will cause chloracne; a painful and disfiguring condition resulting from exposure to various chlorinated hydrocarbons.

More important than the short term acute effects of PCBs are the suspected carcinogenic, teratogenic, and reproductive effects. PCBs have been found to induce tumors in experimental animals after repeated oral ingestion and some studies indicate they cause an increased rate of liver cancer in humans. PCBs have often been demonstrated to contain trace amounts of dioxin or dibenzofurans. Both of these compounds have been demonstrated to be extremely toxic to lab animals.

Because of these findings, it has been concluded by NIOSH that PCBs are potential human carcinogens. Some epidemiological studies have also indicated an elevated number of first-born infants with cleft palate when pregnant mothers were exposed to PCBs. Therefore, it is suspected that they may also have both teratogenic and reproductive effects.

In most situations, the primary route of exposure for PCBs is dermal in nature due to their low volatility. The American Conference of Governmental Industrial Hygienist (ACGIH) Threshold Limit Value (TLV) and federal OSHA Permissible Exposure Limits (PEL) are shown in Table B-7.

3.6.6 Chlorinated Solvents

Chlorinated solvents consist of a family of liquid industrial compounds that contain chlorine, carbon, and hydrogen as a chemical base. They are widely used for a variety of industrial purposes. Exposure thresholds are shown in Table B-8.

The most common chlorinated solvents are tetrachloroethene (PCE) and trichloroethene (TCE). PCE is a colorless liquid with a mild chloroform-like odor. It has a vapor pressure of 14 mm of mercury and a vapor density of 5.76, which indicates that the chemical is somewhat volatile but the vapors are very dense and will tend to build up in low spots (e.g., trenches and excavations).

Both the NIOSH and the ACGIH identify PCE as a potential human carcinogen. The target organ for PCE is the liver, kidneys, eyes, upper respiratory system and the central nervous system (CNS). Signs and symptoms of overexposure are: irritated eyes, nose and throat; nausea, flushed face, vertigo, dizziness, in coordination, headache, somnolence, skin erythema, and long term liver damage. First aid for contact with liquid PCE is to immediately wash the affected area with soap

and water. Medical attention should be sought for other difficulties mentioned above.

TCE is a colorless liquid with a chloroform type odor. It has a vapor pressure of 19 mm of mercury and a vapor density of 4.53, which indicates that it is volatile, and its vapors will tend to settle in low spots (trenches, excavations). Both NIOSH and the ACGIH consider TCE a potential human carcinogen. The target organs for TCE are the CNS, the eyes, nose, liver and kidneys. Symptoms of overexposure include: irritation of the eyes and nose, CNS, and long term liver and kidney damage. First aid for liquid skin contact is to immediately wash the area with soap and water. Medical attention should be sought if any of the other signs and symptoms occur.

Vinyl chloride is a colorless gas at room temperature with a pleasant odor at high concentrations. It is slightly soluble in water and is highly flammable. It is considered a severe irritant to the skin, eyes, and mucous membranes. Both the NIOSH and the ACGIH identify vinyl chloride as a potential human carcinogen. The target organs for vinyl chloride are the respiratory system, lymphatic system, central nervous system, and the liver. Signs and symptoms of overexposure are: weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, liver cancer, pallor, or cyanosis extremities, and frostbite (liquid). If exposure to vinyl chloride occurs, move the person from the contaminated zone to fresh air, wash contaminated area with warm water if frostbite has occurred until circulation is restored, and monitor for consciousness. Medical attention should be sought if any of the other signs or symptoms occur.

1,2-Dichloroethane (1,2-DCA) is a thick, colorless liquid with a sweet taste and chloroform-like odor. It is considered a probable human carcinogen. The target organs for 1,2-DCA are eyes, skin, kidneys, liver, cardiovascular system, and central nervous system. Symptoms of overexposure to 1,2-DCA include irritated eyes, corneal opacity, depression of the central nervous system, vomiting, dermatitis, liver, kidney, and cardiovascular damage. First aid for contact with 1,2-DCA is to immediately wash the area with soap and water. Medical attention should be sought if any of the other signs or symptoms occur.

Cis-1,2-dichlorethene an isomer of 1,2-dichloroethene. It is a flammable, colorless liquid with a harsh odor. Both the cis and trans isomers of 1,2-dichloroethene are an eye irritants, and may affect the respiratory and central nervous systems. First aid for liquid skin contact is to wash the area with soap and water. Medical attention should be sought if any other symptoms occur.

Ethane is an odorless, colorless gas or liquid under pressure. Acute exposure to ethane can cause headache, nausea, vomiting, and dizziness. High concentrations of ethane can result in suffocation from the lack of oxygen. Dermal contact with ethane may result in frostbite.

3.6.7 Other Volatile Organic Compounds

Volatile organic compounds are compounds that have a high vapor pressure and low water solubility. This section covers 1,2-dichloropropane; 1,2-dibromo-3-chloropropane, phenol, carbon tetrachloride, chlorobenzene, methylene chloride, trichlorobenzene, 1,3-dichlorobenzene, cis-1,3-dichloropropene, and trichlorofluoromethane. Exposure thresholds are shown in Table B-9.

1,2-Dichloropropane (1,2-DCP) is a colorless organic liquid with a chloroform-like odor. It can cause irritation to the eyes, skin, and nose. Target organs include the central nervous system, skin,

eyes, and respiratory system. NIOSH considers this compound a carcinogen. If exposure occurs, wash the affected area with water and seek medical attention.

1,2-Dibromo-3-chloropropane is a dense yellow or amber liquid with a strong odor at high concentrations. Acute exposure to this compound may irritate the eyes, skin, and respiratory tract, affect the central nervous system and kidneys, and lower consciousness. Chronic exposure may affect the kidneys, lungs, liver, and testes and cause toxicity to human reproduction. NIOSH considers this compound an animal carcinogen. If contact occurs, wash the exposed area with soap and water. Seek medical attention if any symptoms occur.

Phenol is a colorless to light pink crystalline solid with a sweet, acrid odor. Exposure to phenol may irritate eyes, nose, and throat; cause muscle pain; produce dark urine, tremors, convulsions, kidney damage, and liver damage. If exposure occurs, wash the contact area with soap and water. Seek medical attention if symptoms occur.

Carbon tetrachloride is a colorless liquid with an ether-like odor. Symptoms of exposure to carbon tetrachloride are irritated eyes and skin, depression of the central nervous system, nausea, vomiting, liver and kidney damage, incoordination, drowsiness, and dizziness. NIOSH and ACGIH consider carbon tetrachloride a carcinogen. If contact occurs, wash the area with soap and water and seek medical attention.

Chlorobenzene is a colorless liquid with an almond-like odor. Exposure to chlorobenzene may produce irritation to the eyes, skin, and nose, drowsiness, liver damage, and depression of the central nervous system. If contact occurs, wash the area with soap and water and seek medical attention.

Methylene chloride is a colorless liquid with a sweet, chloroform-like odor (which is not noticeable at dangerous concentrations). Exposure to methylene chloride can irritate eyes and skin, cause nausea, vomiting, fatigue, weakness, unnatural drowsiness, lightheadedness, and numbness. In animals methylene chloride causes tumors in the lungs, liver, salivary glands, and mammary glands. NIOSH considers this compound a carcinogen. If exposure occurs, wash the area with soap and water and seek medical attention.

1,2,4-Trichlorobenzene is a colorless liquid or crystalline solid (at cold temperatures) with an aromatic odor. Exposure to 1,2,4-trichlorobenzene may produce irritation to the eyes and nose, depression of the central nervous system, and damage the liver and kidneys. This compound is considered a carcinogen by NIOSH. If exposure occurs, wash the area with soap and water and seek medical attention.

1,3-Dichloropropene is a colorless to light yellow liquid with a sharp, chloroform-like odor. 1,3-dichloropropene exists as a mixture of cis- and trans-isomers. Exposure to 1,3-dichloropropene may irritate eyes, skin, and upper respiratory system; cause headaches and dizziness. In animals, it may cause liver and kidney damage. NIOSH considers 1,3-dichloropropene a carcinogen. If exposure occurs, wash the area with soap and water and seek medical attention.

Trichlorofluoromethane is a colorless liquid or gas with a mild, ether-like odor at high concentrations. Exposure to trichlorofluoromethane may cause incoherence, tremors, cardiac arrhythmia, cardiac arrest, and frostbite (skin contact with liquid form). It can also cause

asphyxiation at high concentrations. If exposure occurs, flush the exposed area with water and immediately seek medical attention.

1,3-Dichlorobenzene is a colorless liquid. Exposure to 1,3-dichlorobenzene may cause coughing, drowsiness, nausea, sore throat, vomiting, and irritation to the skin and eyes. Chronic term exposure may cause liver and kidney damage. If exposure occurs, rinse the area with water and seek medical attention.

3.6.8 Semivolatile Organic Compounds

Bis(2-ethylhexyl)phthalate (DEHP) is an oily, colorless liquid with a slight odor. It is widely used in plastics to increase flexibility and as a replacement for PCBs in dielectric fluids. DEHP may be present in wall coverings, tablecloths, shower curtains, and some toys. DEHP is insoluble in water, soluble in most organic solvents, and easily dissolved in most body fluids. It is a combustible liquid, but not readily ignitable. Exposure to DEHP generally occurs through ingestion or absorption of high concentrations of DEHP over a long period of time. Repeated exposure may affect the kidneys and liver, and may produce tingling or numbness to the arms and legs. DEHP is a carcinogen and it damages the liver, kidneys, and reproductive system in animals. If exposure does occur, rinse the exposed area with soap and water. If any symptoms occur, seek medical attention. Exposure thresholds are shown in Table B-10.

3.6.9 Heavy Metals

Heavy metals are a group of naturally occurring elements that are widely used in industrial applications. Common heavy metals typically include mercury, lead, chromium, cadmium, and arsenic. Exposure to heavy metals is element-specific and also depends upon oxidation state, concentration, and duration of exposure. The main routes of exposure to heavy metal compounds are through inhalation and ingestion. Heavy metals tend to deposit in tissues such as the liver, kidneys, bone, and blood. Acute exposure may produce neurologic effects, gastrointestinal problems, nausea, fatigue and edema, while long term exposure may cause cancer or damage an unborn fetus. This plan specifically covers manganese, thallium, chromium, hexavalent chromium. Exposure thresholds are shown in Table B-11.

Target organs for exposure to manganese are the eyes, skin, and respiratory system. Exposure may produce symptoms that include irritated eyes, nose, metal fume fever, cough, dust pain, flu-like fever. If exposure to manganese occurs, seek medical attention immediately.

Thallium in its pure form is a blue-white metal found in trace amounts in the environment. Thallium is often found combined with other substances like chlorine, bromine, or iodine. Its appearance and properties vary depending upon its combination with other compounds. Exposure to thallium may produce symptoms of nausea, diarrhea, abdominal pain, chest pain, pulmonary edema, psychosis, liver, and kidney damage. Target organs for thallium include the eyes, respiratory system, central nervous system, liver, kidneys, gastrointestinal tract, and body hair. If exposure occurs, wash the exposed area with soap and water. If other symptoms occur, seek medical attention immediately.

Chromium metal in its pure form is a brittle blue-white to steel gray solid. Chromium is often

found combined with other compounds. Chromium (III) occurs naturally in the environment while Chromium (VI) and Chromium (0) are produced by industrial processes. Inhalation exposure to hexavalent chromium may produce irritation to the nose, nosebleeds, and ulcers in the nasal septum. Ingestion of hexavalent chromium may cause gastrointestinal problems, stomach ulcers, convulsions, kidney damage, and liver damage. Skin contact to hexavalent or trivalent chromium can cause skin ulcers or redness and swelling in certain people. If exposure to chromium occurs, wash exposed area with soap and water. If the exposure occurs through inhalation, or if any symptoms occur, seek medical attention immediately.

3.6.10 Pesticides

Chlordane is included within the family of organochlorine pesticides, pesticides based on carbon, hydrogen, and chlorine. Organochlorine pesticides are not found naturally in the environment. They were used to control a variety of insect pests on crops like corn, citrus, and nuts, on landscaping, and on roadsides. Exposure to organochlorine pesticides usually concerns chronic, or repeated exposure, rather than acute exposure. The main routes of exposure to organochlorine pesticides are through inhalation, ingestion, and skin absorption. Chlordane is a viscous, amber colored liquid with a pungent odor. It is very soluble in water and relatively noncombustible, although it may be used in flammable solutions. Chlordane is composed of twenty-three components, which may include isomers, such as alphB-chlordane and gammB-chlordane. Exposure to chlordane may result in symptoms of blurred vision, confusion, ataxia, delirium, coughing, abdominal pain, vomiting, diarrhea, irritability, tremors, convulsions, and anuria. Chlordane is believed to cause liver and kidney damage in animals. If exposure to chlordane occurs, wash the affected area with soap and water. Seek medical attention if other symptoms occur. Exposure thresholds are shown in Table B-12.

3.6.11 Polynuclear Aromatic Hydrocarbons

Polynuclear Aromatic Hydrocarbons (PAHs) are a family of organic compounds based on multiple carbon ring structures. Although PAHs can be found naturally, the majority of compounds are associated with domestic energy production. PAHs are soluble in fats, oils, and other solvents. The main routes of exposure are typically through ingestion or inhalation. Exposure thresholds are shown in Table B-13.

Naphthalene is a colorless to brown solid that has an odor of mothballs. It is a natural component of petroleum and coal, and a combustion byproduct of wood. Naphthalene is mainly used as an intermediate in the manufacture of resins, plasticizers, dyes, and other materials. Naphthalene is volatile, soluble in water at 20 degrees Celsius, and is a moderate fire hazard when exposed to heat or flame. The target organs for naphthalene are the eyes, skin, blood, liver, kidneys, and central nervous system. Chronic exposure to naphthalene may produce symptoms of irritation to the eyes, headaches, confusion, excitement, vomiting, abdominal pain, renal shutdown, dermatitis, and profuse sweating. First aid for contact with naphthalene is to immediately wash the area with soap and water. Medical attention should be sought if any of the other signs or symptoms occur. Very little information is available on 2-methylnaphthalene. 2-methylnaphthalene is a natural component of crude oil and coal, and is also produced in pyrolysis and combustion by-products. Like naphthalene, 2-methylnaphthalene is present in a solid form, usually crystalline. It is known to

decompose upon heating, producing acrid smoke and irritation fumes. Exposure to 2-methylnaphthalene may produce irritation to eyes and skin. If exposure to this compound occurs, rinse the exposed area with soap and water. There are no established TLVs or PELs for this compound.

4.0 General Safety and Health Requirements

4.1 Medical Clearance and Monitoring

All project personnel who may be required to wear respirators must have on file evidence that they have been cleared by a physician to wear a respirator. All personnel under subcontract to CE2 must also provide this evidence to the SSHO.

4.2 Safety Orientation Meeting

All applicable field personnel must attend a safety orientation meeting before commencing the fieldwork. The meeting will be scheduled and conducted by the Project Manager or the SSHO. The meeting will include presentation of the SSHP, Activity Hazard Analyses, and receipt by the SSHO of the required signed releases.

4.3 Exclusion Zone

Generally a restricted access work zone (25-foot wide) will be maintained around the work areas. Because the project site is secure, the restricted access work zone requirement may be waived at the discretion of the Project Manager. Protective clothing and equipment are to be worn by all personnel working within the restricted access work zone. The purpose of the restricted access work zone is to provide points of ingress and egress for personnel and equipment. The zone is to be demarcated with caution/hazard tape and barricades (or similar restricting material). The restricted access work zone is to be clearly labeled as such. In addition to the restricted access work zone, a gate should restrict vehicular access to the site.

4.4 Buddy System

All field personnel while working in the restricted access work zone during the field activities are to work with another person at the site. Under no circumstances, other than completion of paper work at the end of the day, are field personnel to work alone at the site while conducting field activities.

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5.0 Monitoring

Required monitoring equipment includes:

- Organic vapor analyzer-flame ionization detector (OVA-FID),
- Organic vapor analyzer-photoionization detector (OVA-PID), and
- Combustible gas indicator (explosimeter).

Air monitoring will be performed during drilling, sampling, and monitoring activities utilizing a field operated OVA-FID, OVA-PID, and combustible gas indicator to assess appropriate safety and health protection levels within the Exclusion Zone. Background levels of volatile organics in air will be monitored in areas away from the influence of possible vapor releases. VOCs will be monitored at the borehole and near worker's breathing zones, combustible gasses will be monitored at the borehole only. Tables 14 and 15 summarize action levels for respiratory protection and combustible gasses, respectively. If corrective action cannot be taken, field personnel and other individuals in the area must be directed to move to a safe area. The SSHO and Navy and Project Managers must also be contacted.

The SSHO will be responsible for determining whether additional exposure monitoring/sampling is needed to supplement the equipment and methods described above. The SSHO will also ensure that the instruments described above are operated and interpreted only by persons who have had prior training and experience in their operation, calibration, and care, and who understand their limitations. The SSHO will also ensure that the instruments are being properly calibrated and that the calibration and proper operation of the instruments are checked and documented daily.

The OVA equipment will be calibrated both before and after field operations or as deemed necessary during field operations. The instruments will be calibrated directly to the type calibration gas used by the equipment manufacturer. The calibration gas and the calibration readings (in ppm equivalent) will be recorded in the field log book.

It should be noted that the OVA-FID hydrogen flame could extinguish in low oxygen environments. In addition, high humidity environments can cause an OVA-PID instrument to indicate lower organic vapor concentrations than actually exist.

The SSHO will be responsible for interpreting monitoring data and upgrading or downgrading the level of protection during field activities.

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6.0 Personal Protective Equipment

The employment of engineering controls is the preferred method of providing personal protection from hazards identified at this and any site. It provides acceptable secondary recourse, but only when engineering controls fail or cannot adequately eliminate exposure to the hazard. The use of PPE is intended to provide protection for onsite personnel from chemical, physical, and operational hazards that cannot be controlled through other safety procedures.

Initial PPE for this project will include Level D PPE:

- Hard hat,
- Safety glasses/goggles/face shield,
- Steel-toed boots,
- Disposable inner gloves (latex or nitrile),
- Leather gloves,
- Ear plugs/muffs, and
- Safety vest.

The PPE procedures for this project are further described below.

6.1 Respiratory Protection

As indicated above, respiratory protection will not be required during field activities unless determined by the SSHO that the respiratory protection action levels shown on Table B-14 are exceeded. When applicable, personnel will don an air-purifying respirator (NIOSH approved half-face or full-face, air-purifying respirator fitted with the appropriate HEPA filter cartridge). Personnel wearing respirators will have met medical and fitting requirements in accordance with 29 CFR 1910.134.

6.2 Protective Clothing

The protective equipment to be donned by personnel working in the Exclusion Zone is:

- **Body Protection:** Body protection will include the use of work clothing, including long pants. Tyvek coveralls may be required to minimize direct contact with work clothing. Safety vests are required.
- **Head Protection:** Non-metallic hard hats will be worn by all personnel.
- **Foot Protection:** Foot protection will include the use of sturdy steel-toed boots.
- **Hearing Protection:** Hearing protection will include the use of disposable foam ear inserts or muffs.
- **Eye Protection:** Safety glasses will be worn by personnel working in direct proximity to operating heavy equipment, contaminated soil or groundwater, or samples containing

preservatives such as hydrochloric acid.

6.3 Miscellaneous Safety Equipment

Additional protective equipment that may be donned by personnel working in applicable exclusion zones includes:

- **Fall Protection:** Personnel will wear harnesses with lifelines secured whenever climbing 2 meters above applicable working platforms or surfaces.
- **Communication:** Portable radios/walkie-talkies/mobile phones will accompany field personnel.

These levels may be upgraded by anyone, with prior notification to management personnel, but will only be downgraded upon approval by either the SSHO or the equivalent.

7.0 Decontamination

The following decontamination (cleansing/disposal) procedures for equipment and PPE have been developed with the intent of reducing the potential for cross-contaminating groundwater and the transfer of contaminated material outside the Exclusion Zone. Decontamination should be performed in direct proximity to the Exclusion Zone.

7.1 Contamination Reduction Zone

The Contamination Reduction Zone (CRZ) is a transition area at/near the exclusion zone to dispose of consumable PPE and perform personal hygiene cleaning.

7.2 Equipment Decontamination

Decontamination of equipment will include double washing with a solution of Alconox (or an equivalent laboratory detergent) and tap water and rinsing with distilled or deionized water before vacating the CRZ.

- Scrub with detergent in a bucket,
- Scrub a second time with detergent in a different bucket,
- Rinse with tap water,
- Rinse twice with deionized or distilled water,
- Let air dry or use again, and
- Maintain plastic sheeting, aluminum foil, or other disposable clean surface for air drying.

7.3 Personal Protective equipment Decontamination

Decontamination of PPE will be accomplished by passing personnel through various stages of contamination reduction and removing impacted clothing and/or equipment in decreasing order of the degree of potential impact. Personnel who have come in contact with areas of significant contamination will be subjected to these procedures. The personnel decontamination may be comprised of the following procedural stages.

7.3.1 Stage No. 1: Segregated Equipment Drop

Equipment and consumables that require either disposal or special handling (e.g., special washing/decontamination) will remain in this area until decontaminated or disposed.

7.3.2 Stage No. 2: Protective Clothing Removal

Decontaminate and/or remove all but inner gloves and respirator and dispose of, or store accordingly.

7.3.3 Stage No. 3: Respirator Removal

Remove respirator, decontaminate, and dispose of cartridges daily.

7.3.4 Stage No. 4: General Field Wash

Personnel will remove inner gloves and wash face and hands with hand soap and tap water and rinsing with tap water before leaving the site and/or eating. A drum will be available at the CRZ to store/dispose of potentially impacted consumables. The disposition of this waste will be determined prior to the termination of work.

8.0 Emergency Response Procedures

8.1 Physical Injury

In the event of an accident resulting in physical injury, call emergency service personnel immediately and perform first aid commensurate with training and seriousness of the injury. Severely injured personnel are to be transported only by emergency service personnel and/or by ambulance personnel, unless a life-threatening condition is judged to exist that must be addressed immediately. At the hospital, a physician's attention is mandatory regardless of how serious the injury appears.

The Navy RPM, Navy ROICC, Project Manager, and Program Safety and Health Officer are to be notified by the SSHO, as soon after the injury as practical, regarding the nature of the accident. A written report is also to be prepared and submitted by the SSHO to the Project Safety and Health Officer within 24 hours of the accident. If the SSHO is unable to make the report (due to injury), an individual designated by the Project Manager will make the report.

8.2 Fire, Explosion, and Property Damage

In the event of a fire or explosion notify the fire department immediately by dialing 911.

The Navy RPM, Navy ROICC, Project Manager, and Program Safety and Health Officer are to be notified by the SSHO as soon as practical and a written report prepared by the SSHO within 24 hours of the accident.

Any accident involving serious injury (e.g., of sufficient magnitude that work at the site will cease) will be reviewed by the Navy RPM or their designee. The Navy RPM or designee will complete a review of events and conditions before authorizing work to resume.

8.3 Emergency Telephone Numbers

Fire Department	911
Police Department.....	911
Paramedics	911
Navy RPM, Ryan Ahlersmeyer	(619) 532-0960
Navy ROICC, Peter Stroganoff	(510) 749-5941
Project Manager, Robert Ferry	(925) 872-7264
Program Safety and Health Officer, Richard Bohrer.....	(916) 336-1701
QA Program Manager, Gary Goodemote	(510) 628-9000

Other phone numbers may be available or required for emergency response at specific sites. Check with onsite representatives before mobilizing to the job site.

8.4 Hospital Addresses and Route

The nearest medical facility is San Francisco General Hospital, located at Potrero Avenue and 22nd Street. The telephone number for San Francisco General Hospital is (415) 206-8000. A map showing the driving directions to the hospital is presented as Figure B-1.

8.5 Safety and Health Plan Site Personnel Training Roster

Onsite will be required to document by signature that they have reviewed this SSHP and agree to follow the provisions of this document. Documentation will be by using a signature sheet.

9.0 References

- ACGIH, 2001. "Documentation of the Threshold Limit Values for Chemical Substances, 7th Edition." 2760 pages.
- NIOSH, 1981. "Occupational Health Guidelines for Chemical Hazards." DHHS (NIOSH) Publication No. 81-123. January,
- OSHA, 1988. "Personal Exposure Limit (PEL) Project Documentation." The PEL database is derived from OSHA comments from the January 19, 1989 Final Rule on Air Contaminants Project extracted from 4FR2332 et. seq. The U.S. Circuit Court of Appeals remanded this rule and the limits are not currently in force.
- Tetra Tech, 2004. "Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan), Basewide Groundwater Monitoring Program, Hunters Point Shipyard, San Francisco, California." DS.A057.10721. August 20.
- U.S. Army Corps of Engineers, 2003. "Safety and Health Requirements Manual." EM385-1-1. November 3.

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Tables

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Table B-1. Minimum illumination.

Foot candles	Area of operations
5	General construction.
3	General construction, concrete placement, excavation/waste areas, access ways, active storage areas, loading platforms, refueling and maintenance areas.
5	Indoors, warehouses, corridors, hallways, and exits.
5	Tunnels, shafts, general underground work (note exception of 10 foot candles required for operations such as drilling, mucking, and scaling.
10	General construction plants and shops.
30	First Aid stations, infirmaries, and offices.

Table B-2. Temperature equivalence.

Adjusted temperature °F	Permeable clothing work prior to break (min)	Impermeable clothing work prior to break (min)
72.5 - 77.5	150	120
77.5 - 82.5	120	90
82.5 - 87.5	90	60
87.5 - 92.5	60	30
92.5 or greater	45	15

Table B-3. Gasoline exposure thresholds.

Chemical name and CAS number	Route of entry	Published exposure limits		
		Category	Concentration	Source
Gasoline 8006-61-9	Inhalation, dermal	TLV	300 ppm 8-hr. TWA 500 ppm STEL	ACGIH

Notes:

ACGIH - American Conference of Governmental Industrial Hygienists.

CAS - Chemical abstract substance number.

mg/m3 - Milligrams per cubic meter.

N/A - Not applicable

NIOSH - National Institute of Occupational Safety and Health.

OSHA - Occupational Safety and Health Administration.

PEL - Permissible Exposure Limit.

ppm - Parts per million.

STEL - Short-term exposure limit.

TLV - Threshold Limit Value.

Table B-4. Aromatic petroleum distillates exposure thresholds.

Chemical name and CAS number	Route of entry	Published exposure limits		
		Category	Concentration	Source
Benzene 71-43-2	Inhalation, dermal	TLV	0.5 ppm 8-hr. TWA 2.5 ppm STEL	ACGIH
1,2-Dichlorobenzene 95-50-1	Inhalation, dermal	TLV	25 ppm 8-hr. TWA 50 ppm STEL	ACGIH
1,4-Dichlorobenzene 106-46-7	Inhalation, dermal	TLV	10 ppm	ACGIH

Note:

See Table B-3 notes for definitions and acronyms.

Table B-5. Diesel fuel exposure thresholds.

Chemical name and CAS number	Route of entry	Published exposure limits		
		Category	Concentration	Source
Diesel Fuel 68476-31-3	Inhalation, dermal	TLV	100 ppm 8-hr. TWA	ACGIH

Note:

See Table B-3 notes for definitions and acronyms.

Table B-6. Used waste oils exposure thresholds.

Chemical name and CAS number	Route of entry	Published exposure limits		
		Category	Concentration	Source
Used Waste	Dermal	None Published		
Oils (Slop Oil)	Dermal	None Published		
Transmission Fluid	Dermal	None Published		
Hydraulic Fluid	Dermal	None Published		

Note:

See Table B-3 notes for definitions and acronyms.

Table B-7. Polychlorinated biphenyls exposure thresholds.

Chemical name and CAS number	Route of entry	Published exposure limits		
		Category	Concentration	Source
Aroclor 1260 11096-82-5	Inhalation, dermal	TLV	0.5 mg/m3 8-hr TWA	NIOSH

Note:

See Table B-3 notes for definitions and acronyms.

Table B-8. Chlorinated solvents exposure thresholds.

Chemical name and CAS number	Route of entry	Published exposure limits		
		Category	Category	Source
Tetrachloroethene (PCE) 127-18-4	Inhalation	TLV	25 ppm	ACGIH
Trichloroethene (TCE) 79-01-6	Inhalation	TLV	50 ppm 8-hr TWA	ACGIH
Vinyl Chloride 75-01-4	Dermal, inhalation	TLV	1 ppm 8-hr TWA	ACGIH
1,2-Dichloroethane 107-06-2	Inhalation	TLV	100 ppm 8-hr TWA	ACGIH
Cis-1,2-Dichloroethene 156-59-2	Inhalation, ingestion	TLV	200 ppm 8-hr TWA	ACGIH
Ethane 74-84-0	Inhalation, dermal	TLV	Simple asphyxiant (STEL)	ACGIH

Note:

See Table B-3 notes for definitions and acronyms.

Table B-9. Other volatile organic compounds exposure thresholds.

Chemical name and CAS number	Route of entry	Published exposure limits		
		Category	Concentration	Source
1,2-Dichloropropane 78-87-5	Inhalation, ingestion, dermal	TLV	75 ppm 8-hr TWA 110 ppm STEL	ACGIH
1,2-Dibromo-3-chloropropane 96-12-8	Inhalation, ingestion, dermal	OSHA	0.001 ppm	NIOSH
Phenol 108-95-2	Dermal, inhalation	TLV	5 ppm 8-hr TWA	ACGIH
Carbon tetrachloride 56-23-5	Inhalation, ingestion, dermal	TLV	5 ppm 8-hr TWA 10 ppm STEL	ACGIH
Chlorobenzene 108-90-7	Inhalation, ingestion, dermal	TLV	10 ppm 8-hr TWA	ACGIH
Methylene chloride 75-09-2	Inhalation, absorption, ingestion	TLV	50 ppm 8-hr TWA	ACGIH
1,2,4-Trichlorobenzene 120-82-1	Inhalation, ingestion, dermal	TLV	5 ppm STEL	ACGIH
1,3-Dichlorobenzene 541-73-1	Inhalation, Ingestion	TLV	Not established	ACGIH
Cis-1,3-Dichloropropene 542-75-6	Inhalation, ingestion, absorption, dermal	TLV	1 ppm 8-hr TWA	ACGIH
Trichlorofluoromethane 75-69-4	Inhalation, ingestion, dermal	TLV	1,000 ppm STEL	ACGIH

Note:

See Table B-3 notes for definitions and acronyms.

Table B-10. Semivolatile organic compounds exposure thresholds.

Chemical name and CAS number	Route of entry	Published exposure limits		
		Category	Concentration	Source
Bis(2-ethylhexyl) phthalate 117-81-7	Ingestion, inhalation	TLV	None published	ACGIH

Note:

See Table B-3 notes for definitions and acronyms.

Table B-11. Heavy metals exposure thresholds.

Chemical name and CAS number	Route of entry	Published exposure limits		
		Category	Concentration	Source
Chromium 7440-47-3	Inhalation, ingestion	TLV	0.5 mg/m ³ 8-hour TWA	NIOSH
Chromium (VI)	Inhalation, ingestion	TLV	0.1 mg/m ³ 8-hour TWA for water soluble Cr VI compounds 0.05 mg/m ³ 8-hour TWA for insoluble Cr VI	ACGIH
Manganese 7439-96-5	Inhalation, ingestion	TLV	0.2 mg/m ³ 8-hour TWA	ACGIH
Thallium 7440-28-0	Inhalation, ingestion	TLV	0.1 mg/m ³ 8-hour TWA	ACGIH

Note:

See Table B-3 notes for definitions and acronyms.

Table B-12. Pesticides exposure thresholds.

Chemical name and CAS number	Route of entry	Published exposure limits		
		Category	Concentration	Source
AlphB-chlordane 510-371-9	Inhalation, dermal, ingestion	TLV	0.5 mg/m ³ 8-hour TWA	ACGIH
GammB-chlordane 510-374-2	Inhalation, dermal, ingestion	TLV	0.5 mg/m ³ 8-hour TWA	ACGIH

Note:

See Table B-3 notes for definitions and acronyms.

Table B-13. Polynuclear aromatic hydrocarbons exposure thresholds.

Chemical name and CAS number	Route of entry	Published exposure limits		
		Category	Concentration	Source
2-methylnapthalene 91-57-6	Inhalation, ingestion	TLV	Not established	ACGIH
Naphthalene 91-20-3	Dermal, inhalation	TLV	10 ppm 8-hour TWA 15 ppm STEL	ACGIH

Note:

See Table B-3 notes for definitions and acronyms.

Table B-14. Respiratory protection action levels.

Level measured by calibrated OVA	Action
Less than 5 ppm for more than 1 minute	Continue OVA monitoring at specified frequency and duration.
5 ppm to 24 ppm for more than 1 minute	Measure level by benzene Draeger Tube test. If less than 1 ppm, respirators not required. If greater than 1 ppm, respirators required.
25 ppm to 99 ppm	Respirators required.
100 ppm or greater	Stop work, move personnel out of area, contact Project Manager. More stringent respiratory protection may be required.

Notes:

OVA - Organic Vapor Analyzer.

ppm - Parts per million.

Table B-15. Combustible gas protection action levels.

Level measured by calibrated combustible gas indicator (explosimeter)	Action
Less than 10% of LEL	No action required.
10% to 20% of LEL	Start continuous monitoring. Permit only classified electrical equipment and non-sparking tools.
Greater than 20% of LEL	Stop work, safety ascertain source of gas.

Note:

LEL – Lower explosive limit.

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Figures

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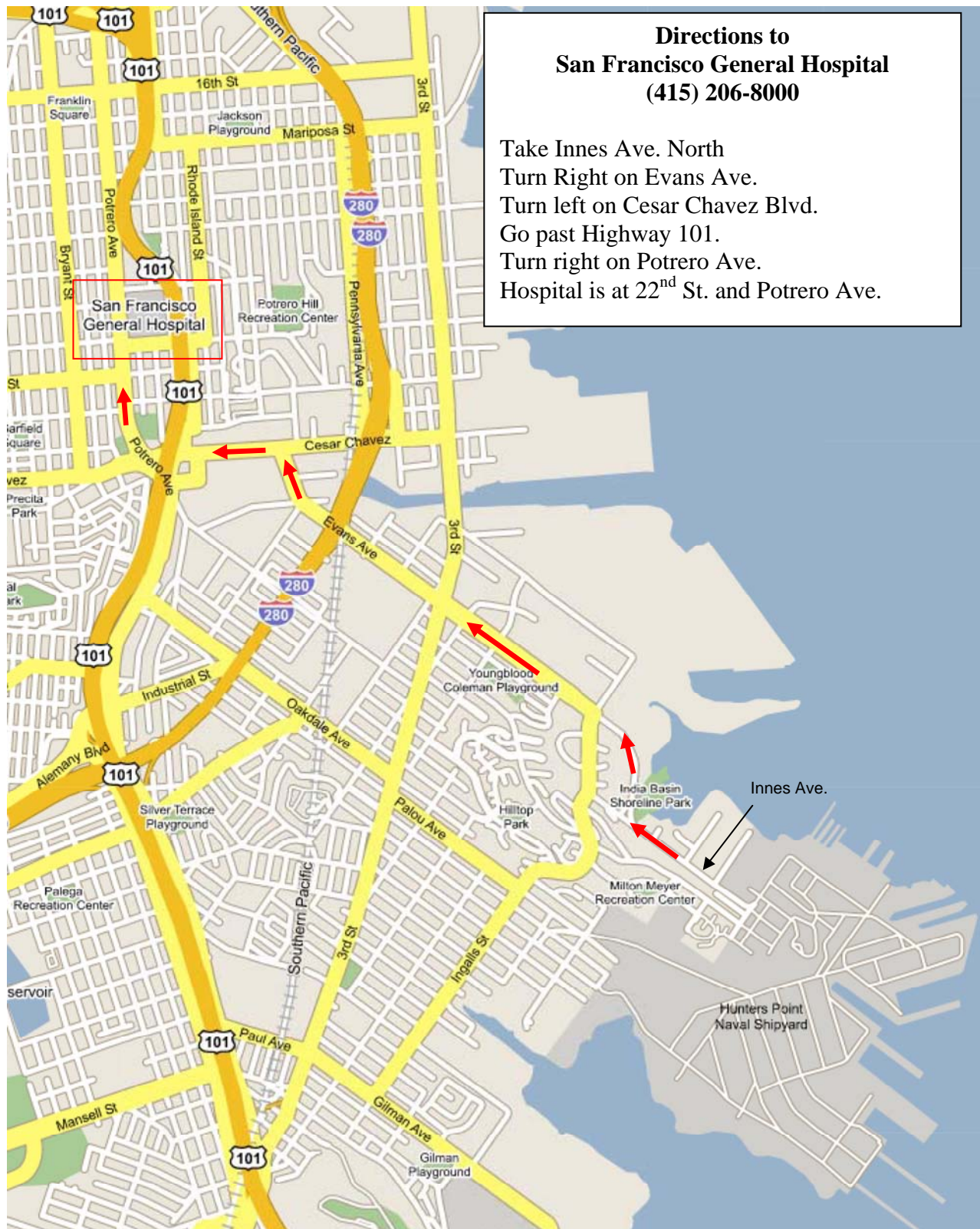


Figure B-1. Directions to Hospital.

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Attachments

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Attachment B-1:
Activity Hazard Analysis (AHA)
Passive Soil Gas Sampling at Remedial Unit C5
Hunters Point Shipyard

Section 1

Location Hunters Point Shipyard San Francisco, California	Contract No.: N68711-05-C-6406	Project Title Contamination Delineation at Remedial Unit C5
Activity Passive Soil Gas Sampling	Prime Contractor: CE2 Corporation Robert Ferry, PG, CHG	Subcontractor: Kleinfelder, Inc. Richard Bohrer, CIH
General Scope of Work for this Activity: The EMFLUX® passive soil gas method will be used to perform a screening-level assessment of the horizontal extent of VOCs in the subsurface along and adjacent to the boundary between Parcels B and C near RU-C5. Approximately 50 sampling locations are planned. Each EMFLUX® sampler consists of two hydrophobic adsorbent cartridges within a 40 milliliter (ml) vial with a gas-permeable septum. If pavement is present, a small opening (approximately 3 inches in size) will be removed to access to the subsurface. To install each sampler, a 1-inch diameter hole is made to a minimum depth of 11 inches using a hammer drill, slide hammer, or comparable equipment (a drill rig will not be used). If permeable sub-base is encountered beneath the pavement, the hole is deepened until less permeable material is reached (maximum depth of 2 ft). A 1-inch diameter metal pipe with a length of 12 to 24 inches is placed in the hole and driven 1 inch into the soil at the bottom of the hole. The purpose of the pipe is to isolate the sampling cartridge from vapor that may have accumulated in permeable sub-base beneath pavement. The length of the pipe will depend on the depth of the drilled hole (i.e., the pipe will be 1 inch longer than the hole is deep). The sampler containing the adsorbent cartridges is suspended within the pipe, and the top of the pipe is covered with an aluminum foil plug and a thin concrete patch to protect the sampler. The samplers will be exposed to subsurface soil gas for 3-7 days. Following the exposure period, the samplers will be retrieved and shipped to the laboratory for analysis.		
Date of Preparatory Inspection: Not applicable		Estimated Start Date of Activity: July 2005

Principal Steps	Potential Safety/Health Hazards	Recommended Controls
All		Personnel must wear hard hats, steel toe boots, and reflective vests at all times in the field.
1. Park contractor vehicle carrying equipment.	Collision.	Use spotters when positioning vehicle. Ensure spotters can communicate with driver.
2. Survey the site.	Slips, trips, and falls.	Inspect work areas visually. Mark, barricade, or eliminate potentially hazardous areas. Keep work area neat and orderly. Maintain proper illumination.
	Failure to properly survey site could cause exposure to electrical and ground hazards.	Identify all overhead electrical hazards, including hazards in the path of equipment during transportation. Identify potential subsurface utilities. Ensure that the results of the survey are addressed in the Activity Hazard Analysis.
3. Unload equipment and materials.	Load could have shifted during transport or be poorly tied down, causing load to be unstable.	If load has shifted or tie-downs are poorly installed, do not stand near truck or load. If necessary, remove each tie-down carefully and position heavy equipment on side where tie-down is being removed to prevent load from falling.
	Lifting equipment and material from vehicle could cause strain to worker.	Use proper lifting techniques. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Cuts and abrasions while moving equipment and materials.	Use leather gloves when moving objects with sharp contact points.
4. Inspect equipment	Workers could be exposed to hazards associated with operating mechanical devices.	Ensure that all equipment is inspected by a competent person and that the equipment is in safe operating condition. Inspect all equipment at the beginning of each shift. Tag and remove from service any faulty or unsafe equipment. Verify that emergency shutdown (if applicable) is clearly marked and the location is known to all site workers. Verify the shutdown system works (if applicable). Provide and follow operating manuals for equipment (if applicable).
5. Ensure that the area has been surveyed for underground utilities and obstructions.	Because the depth of subsurface penetration is 2 ft or less, contact with subsurface utilities is unlikely. However, sampling locations will be chosen that avoid known subsurface utilities.	Coordinate with Navy staff to ensure that no possibility of encountering subsurface utilities exists. Subsurface utility clearance is not required due to the shallow depth of the sampling holes.

Principal Steps	Potential Safety/Health Hazards	Recommended Controls
6. Position and set up equipment.	Worker could be struck by site vehicles when moved.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Barricade and mark sampling locations for visibility.
	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag as out of service). Maintain steady pace and take rest breaks. Select proper hand tools to avoid chronic muscle contraction or steady force, extreme or awkward finger/arm/hand position, repetitive forceful motions, or excessive gripping, pinching, or pressing with the hands and fingers.
	Worker could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear leather gloves, as appropriate. Do not wear gloves when near moving parts to avoid being entangled.
7. Core or cut opening in the pavement.	Worker could be exposed to excessive noise.	Wear ear plugs when coring/cutting concrete, if necessary.
	Worker could come in contact with pavement coring/cutting equipment.	Keep hands and feet well away from the pavement removal activities.
	Worker could be struck by debris from pavement coring/cutting.	If not performing the operation, stand well clear. Wear safety glasses.
8. Advance hole for sampler.	Worker could come in contact with hammer drill or slide hammer.	Keep hands and feet well away from the equipment used to advance the sampling hole while in operation.
	Worker could be exposed to excessive noise.	Wear ear plugs when advancing sampling hole, if necessary.
9. Insert and retrieve sampling devices.	If kneeling to install/retrieve sampling device, worker could be struck by vehicles or equipment.	Ensure that all site workers are aware that workers installing or removing samplers may not be readily visible. Wear reflective vests at all times. Barricade work area, if appropriate.
	Sampling locations could pose trip hazards.	During and following the passive soil gas sampling, ensure that all sampling locations in a safe condition, either by: (1) repairing the ground surface, or (2) placing barricades if the location will be used for future direct-push sampling.
10. Decontaminate all reusable materials and equipment.	Worker could come into contact with contaminants.	No significant decontamination activities will be required. Handle any potentially contaminated equipment as described in the Sampling and Analysis Plan. Wear designated personal protective equipment as specified in the Site-Specific Safety and Health Plan. Handle any waste materials as described in the Investigation-Derived Waste Management Plan.

Section 2

Equipment to be Used	Inspection Requirements	Training Requirements
Pavement coring/cutting equipment	See Principal Step 4.	Verification of subcontractor competency and training will be performed prior to field activities.
Hammer drill, slide hammer, or comparable equipment used to advance sampling hole.	See Principal Step 4.	Verification of subcontractor competency and training will be performed prior to field activities.

Attachment B-2:
Activity Hazard Analysis (AHA)
Direct-Push Technology for Soil Coring and Hydropunch Groundwater Sampling at
Remedial Unit C5
Hunters Point Shipyard

Section 1

Location Hunters Point Shipyard San Francisco, California	Contract No.: N68711-05-C-6406	Project Title Contamination Delineation at Remedial Unit C5
Activity Direct Push Technology	Prime Contractor: CE2 Corporation Robert Ferry, PG, CHG	Subcontractor: Kleinfelder, Inc. Richard Bohrer, CIH
<p>General Scope of Work for this Activity:</p> <p>Direct-Push Technology (DPT) will be used for soil coring and Hydropunch[®] groundwater sampling. Samples obtained with DPT will be used to perform a screening-level assessment of the extent of VOCs in the subsurface along and adjacent to the boundary between Parcels B and C near RU-C5. Approximately 60 sampling locations are planned. DPT uses a truck-mounted hydraulic/percussion system to push a series of 2.5-inch O.D. (outside diameter) steel rods. The steel rods are typically 3-ft in length and have threaded ends. The lead rod is tipped with a drive point and additional rods are added as needed to reach the sampling depth. The DPT rods will be hydraulically pushed to the desired depth. After sampling is complete, the rods will be retrieved and the borehole backfilled with cement, bentonite, or cement/bentonite mixture.</p> <p>Soil coring will be performed to identify permeable sediments. Soil cores will be collected from the ground surface to bedrock encounter (approximately 30 – 50 feet below ground surface). The depths of permeable sediments will be used to identify the depth intervals from which subsequent HydroPunch[®] groundwater will be collected.</p> <p>Groundwater samples will be collected using a Hydropunch[®]. The DPT rods will be pushed to the desired sampling depth, and the Hydropunch[®] retracted to allow groundwater to flow through the screen and into the sampling tip. The Hydropunch[®] has a sacrificial point that will be left in place as the screen assembly is pulled to the surface. Discrete groundwater samples for VOC analysis will be collected using a micro bladder pump, Wattera[®], or comparable sampling system. Samples will be collected directly into pre-cleaned, laboratory-supplied sample containers at a low flow rate to minimize loss of volatiles.</p>		
Date of Preparatory Inspection: Not applicable		Estimated Start Date of Activity: September 2005

Principal Steps	Potential Safety/Health Hazards	Recommended Controls
All		Personnel must wear hard hats, steel toe boots, and reflective vests at all times in the field.
1. Park contractor vehicle carrying equipment.	Collision.	Use spotters when positioning vehicle. Ensure spotters can communicate with driver.
2. Survey the site.	Slips, trips, and falls.	Inspect work areas visually. Mark, barricade, or eliminate potentially hazardous areas. Keep work area neat and orderly. Maintain proper illumination as needed.
	General site hazards pose a risk to worker safety.	Wear proper PPE (personal protective equipment) in accordance with the Site-Specific Safety and Health Plan. PPE should always include steel-toed boots, safety glasses, and reflective vests. Read all applicable material safety data sheets (MSDSs). Keep constantly alert of potential hazards (maintain situational awareness).
	Failure to properly survey the site could cause exposure to electrical and ground hazards.	Identify all overhead electrical hazards, including hazards in the path of equipment during transportation. Identify potential subsurface utilities. Ensure that the results of the survey are addressed in the appropriate Activity Hazard Analysis (AHA).
3. Unload equipment and materials.	Load could have shifted during transport or be poorly tied down, causing load to be unstable.	If load has shifted or tie-downs are poorly installed, do not stand near truck or load. If necessary, remove each tie-down carefully and position heavy equipment on side where tie-down is being removed to prevent load from falling. Wear steel-toe footwear.
	Lifting equipment and material from vehicle could cause strain to worker.	Use proper lifting techniques. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Cuts and abrasions while moving equipment and materials.	Use leather gloves when moving objects with sharp contact points.

Principal Steps	Potential Safety/Health Hazards	Recommended Controls
4. Inspect DPT rig	Improper inspection of rig could cause workers to be exposed to hazards associated with operating mechanical devices.	Ensure that rig and all equipment are inspected by a competent person and that the rig and equipment are in safe operating condition. Inspect equipment, including brakes, tire pressure, cables, and hydraulic/pneumatic hoses before use and at start of each shift. Tag and remove from service any faulty or unsafe equipment. Verify that emergency shutdown control (if applicable) is clearly marked and shown to all site workers. Verify the shutdown system works properly when trip wire or switch is pulled or pushed. Operator's manual must be available and reviewed prior to equipment operation. (Note: a DPT rig does not have a rotating auger.) Provide and follow operating manuals for equipment (if applicable).
5. Ensure that the area has been surveyed for underground utilities and obstructions.	The DPT rods/drive points could contact buried utilities.	A utility clearance will be conducted by a commercial utility locator service that will mark the utility locations with spray paint and/or pin flags. Sample locations will be evaluated with respect to the marked utilities and the sample locations will be discussed with Navy staff knowledgeable with historical utilities and remedial activities. Hand auger to a depth of 5 feet in locations specified by the Navy representative. Engineering drawings will be reviewed if available. The DPT rig will be grounded while in operation.
6. Position and set up of DPT rig and associated equipment.	Worker could be struck by site vehicles when moved.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Barricade and mark sampling locations for visibility.
	Failure to review site layout plan could cause exposure to potential hazards such as electrocution, damaging of underground utilities, or tipping rig over in unstable soil conditions.	Do not move DPT rig into any work area until the site layout has been reviewed and route of travel to any work site has been assessed for hazards (overhead lines and stability of roads and ground). At the pre-activity safety briefing, discuss site layout and travel route, along with other AHAs. Do not place rig within 15 feet of any overhead electrical lines. Use a spotter for positioning as necessary.
	Rig could contact overhead powerlines if transported with mast raised, causing electrical shock.	Never move rig when mast is extended.

Principal Steps	Potential Safety/Health Hazards	Recommended Controls
	Worker could become pinned between rig and other truck components, or worker could be pinned under rig if rig is serviced from beneath the truck.	When any part of rig or equipment is in motion, stand far enough away from moving parts to avoid being pinned between moving parts. Do not work under rig or truck while it is supported by lifting jacks. If work must be done under rig or truck, the drill crew supervisor must contact the Site Safety and Health Officer (SHSO) to ascertain a safe method for lockout of equipment to ensure that adequate blocking is installed.
	High winds could destabilize rig. Mast could act as a conductor (lightning rod) during a thunderstorm.	Check weather conditions and forecast to determine if conditions are acceptable for rig use. Do not operate rig if winds exceed the manufacturer's recommended tolerances.
	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag as "out of service"). Maintain steady pace and take rest breaks. Select proper hand tools to avoid chronic muscle contraction or steady force, extreme or awkward finger/arm/hand position, repetitive forceful motions, or excessive gripping, pinching, or pressing with the hands and fingers.
	Workers could be exposed to excessive noise.	Wear earplugs or earmuffs whenever drill rig is in operation, if necessary.
	Worker could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear leather gloves, as appropriate.
7. Core or cut opening in the pavement.	Improper operation of equipment could injure worker	Verification of subcontractor competency and training will be performed prior to field activities.
	Worker could be exposed to flying debris.	Wear safety glasses.
	Worker could be exposed to excessive noise.	Wear earplugs or earmuffs when coring/cutting concrete, if necessary.
	Worker could be exposed to dust.	Avoid generating dust as much as practical. Wear proper PPE. Stand upwind of operating equipment. After hole is cut, remove PPE properly and wash hands.
	Worker could come in contact with pavement coring/cutting equipment.	Keep hands and feet well away from the pavement removal activities.
	Worker could be struck by debris from pavement coring/cutting.	If not performing the operation, stand well clear.

Principal Steps	Potential Safety/Health Hazards	Recommended Controls
8. Start up DPT rig, advance and retrieve the rods/samplers.	Electrocutions, explosions, or disastrous events.	Obtain and examine copies of all pertinent drawings prior to performing this task. Locate and mark underground utilities using universal marking codes. Hand auger to a depth of 5 ft bgs in the locations specified by the Navy representative. Inspect the area for overhead obstructions. Ensure that rig weight is evenly distributed and not heavy enough to damage underground utilities. Wear reflective vests at all times. Barricade or rope off the work area as appropriate.
	Worker could be exposed to flying equipment or debris.	Wear safety glasses.
	Pressurized hydraulic lines could rupture, causing release of hot hydraulic fluid that could ignite if contact is made with engine, burn workers, and cause environmental contamination.	Ensure that personnel are trained in the used of DPT equipment. Inspect all hydraulic lines before placing rig in service. Any damage hoses or connection must be replaced before unit is used. Immediately shut down equipment if lines rupture. Ensure that first aid kit is readily available to treat injured workers. Ensure that a 20-pound dry chemical ABC fire extinguisher is readily available. Ensure that a spill control kit is available at the sampling location. If a liquid release occurs, berm the area as soon as possible.
	Air hoses or hydraulic hoses under pressure could suddenly release, whip, and strike workers, thus causing severe injury.	Do not disconnect air hoses and compressors until hose pressure has been bled down. Visually inspect all connections. Use safety clamps (whip checks) to connect each side of connection. Tie back or attach hoses whenever possible to minimize length of hose that could whip around.
	Worker could be exposed to chemical agents or contaminants.	Verify selection of PPE with respect to site contaminants. Review MSDSs. Decontaminate DPT components after use (or cover contaminated parts when moving to the next sample location. Avoid exposure to dust and use dust suppression (water spray) if necessary. Containerize and label all decontamination fluids. Determine if PPE is contaminated (based on exposure to contaminants) and place contaminated PPE in a separate, properly labeled, container. Discard PPE in accordance with the Investigation-Derived Waste Management Plan.

Principal Steps	Potential Safety/Health Hazards	Recommended Controls
	Workers could place hands into moving parts of rig, or loose clothing could become entangled in moving machine parts, either of which could injure workers. Workers could be exposed to pinch points.	Safety guards should be used limit personnel access to chains, sprockets, rams, and other moving parts. Do not wear loose clothing or any jewelry. Ensure operator verbally alerts all workers and visually verifies that all workers are clear of dangerous parts of equipment before starting or engaging equipment. Avoid placing hands close to moving machinery. Wear gloves as appropriate.
	Lifting of rods and other equipment could cause worker strain.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limit twisting motions, and getting assistance when moving bulky/heavy materials and equipment.
	Workers could be exposed to excessive noise.	Wear earplugs or earmuffs when advancing sampling hole, if necessary.
9. Field screen the borehole, soil cores, and groundwater with a photoionization detector (PID).	Worker could be exposed to chemical contaminants.	Conduct monitoring with a PID. If organic-compound concentrations in air are lower than 10 ppm, proceed with work activities. If concentrations consistently exceed 10 ppm, secure the area and contact the SHSO.
10. Pour bentonite/cement into borehole	Worker could be exposed to dust.	Avoid generating dust as much as practical. Wear proper PPE. Stand upwind while pouring bentonite/cement powder. After borehole is sealed, remove PPE properly and wash hands.
	Lifting of materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limit twisting motion, and getting assistance when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
11. Decontaminate all reusable materials and equipment.	Worker could come into contact with contaminants.	Handle any potentially contaminated equipment as described in the Sampling and Analysis Plan. Wear designated PPE as specified in the Site-Specific Safety and Health Plan. Handle any waste materials as described in the Investigation-Derived Waste Management Plan.
	Decontamination area may become slippery.	Visually inspect work area and mark, barricade, or eliminate slip, trip, and fall hazards as much as feasible. If decontaminating on plastic sheeting, use caution because plastic sheeting can be extremely slippery. Wear proper boots with good traction.

Principal Steps	Potential Safety/Health Hazards	Recommended Controls
	Lifting of materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with the legs, limiting twisting, and getting assistance when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.

Section 2

Equipment to be Used	Inspection Requirements	Training Requirements
Pavement coring/cutting equipment	See Principal Step 7.	Verification of subcontractor competency and training will be performed prior to field activities.
DPT rig and sampling equipment	See Principal Step 4.	Verification of subcontractor competency and training will be performed prior to field activities.

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Attachment B-3:
Activity Hazard Analysis (AHA)
Groundwater Sampling from Existing Monitoring Wells at Remedial Unit C5
Hunters Point Shipyard

Section 1

Location Hunters Point Shipyard San Francisco, California	Contract No.: N68711-05-C-6406	Project Title Contamination Delineation at Remedial Unit C5
Activity Groundwater sampling	Prime Contractor: CE2 Corporation Robert Ferry, PG, CHG	Subcontractor: Kleinfelder, Inc. Richard Bohrer, CIH
General Scope of Work for this Activity: Collect groundwater samples from five existing monitoring wells at RU-C5. The collection of groundwater samples from existing monitoring wells will be conducted using the procedures presented in the SAP for the Basewide Groundwater Monitoring Program and the Q19 Groundwater Sampling Report. In summary, the procedures are: <ol style="list-style-type: none">1. Inspect monitoring well for damage and/or maintenance issues. Note findings on monitoring well sampling sheet.2. Position electrical generator as far away as practical and downwind of monitoring well.3. Keep ice chest/cooler in shade away from electrical generator. Maintain adequate blue ice.4. Measure and record depth to water and total depth of well.5. Use Photoionization Detector (PID) to monitor ambient air near monitoring well.6. Use new Teflon-lined polyethylene tubing for each well. If appropriate, retrieve dedicated sample tubing from the monitoring well.7. Connect the sample tubing to the stainless-steel low-flow submersible pump.8. For shallow monitoring wells, set tubing inlet at 10 feet above bottom of well. For deeper monitoring wells, set tubing inlet in middle of screened interval.9. Connect sample tubing to flow cell. Use Horiba U-10 water quality meter and Oakton Instrument oxidation-reduction probe. Put outflow hose for purge water into container.10. Start purging groundwater through flow cell. Record the initial water quality parameters (temperature, specific conductance, pH, turbidity, and dissolved oxygen) on monitoring well sampling sheet.11. Record purge-water parameters at 1 liter intervals.12. Purge at least 8 liters of groundwater. After parameters have stabilized, change gloves and collect groundwater samples directly from sample tubing.13. If well draws down excessively (water level declines below pump inlet), wait until well recharges to 80% of initial water level before taking sample.14. Fill VOA bottles. Be careful not to overfill any bottles. Do not flush out preservatives. VOA bottles require no headspace and require a positive meniscus.15. As appropriate, collect QA/QC samples such as duplicates and MS/MSD samples.16. Record sample time and personnel initials on the label for each bottle. Immediately place bottles in ice chest/cooler after filling.17. Decontaminate all sampling equipment with the 3-stage bucket system. All portions of the electronic water-level indicators exposed to groundwater will be decontaminated before each use by washing with a mixture of tap water and Liquinox soap solution and rinsed with tap water followed by deionized (DI) water. Submersible pumps and flow-through cells will be decontaminated before each use by washing the exterior of each pump with DI water and Liquinox soap solution and then pumping a solution of DI water and Liquinox soap through the pump. The pump will then be flushed with tap water followed by DI water.18. Collect rinsate sample (if any) using fresh DI water.19. If appropriate, return dedicated sample tubing to well.20. Close and lock monitoring well. Remove sample equipment from area.		
Date of Preparatory Inspection: Not applicable		Estimated Start Date of Activity: September 2005

Principal Steps	Potential Safety/Health Hazards	Recommended Controls
All		Personnel must wear hard hats, steel toe boots, and reflective vests at all times in the field.
1. Park contractor vehicle carrying equipment.	Collision.	Use spotters when positioning vehicle. Ensure spotters can communicate with driver.
2. Survey the site.	Slips, trips, and falls.	Inspect work areas visually. Mark, barricade, or eliminate potentially hazardous areas. Keep work area neat and orderly. Maintain proper illumination.
	Failure to properly survey site could cause exposure to electrical and ground hazards.	Identify all overhead electrical hazards, including hazards in the path of equipment during transportation. Ensure that the results of the survey are addressed in the Activity Hazard Analysis.
3. Unload equipment and materials.	Load could have shifted during transport or be poorly tied down, causing load to be unstable.	If load has shifted or tie-downs are poorly installed, do not stand near truck or load. If necessary, remove each tie-down carefully and position heavy equipment on side where tie-down is being removed to prevent load from falling.
	Lifting equipment and material from vehicle could cause strain to worker.	Use proper lifting techniques. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Cuts and abrasions while moving equipment and materials.	Use leather gloves when moving objects with sharp contact points.
4. Inspect equipment	Workers could be exposed to hazards associated with operating mechanical devices.	Ensure that all equipment is inspected by a competent person and that the equipment is in safe operating condition. Inspect all equipment at the beginning of each shift. Tag and remove from service any faulty or unsafe equipment. Verify that emergency shutdown (if applicable) is clearly marked and the location is known to all site workers. Verify the shutdown system works (if applicable). Provide and follow operating manuals for equipment (if applicable).
5. Position and set up equipment.	Worker could be struck by site vehicles when moved.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Barricade and mark sampling locations for visibility.

Principal Steps	Potential Safety/Health Hazards	Recommended Controls
	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag as out of service). Maintain steady pace and take rest breaks. Select proper hand tools to avoid chronic muscle contraction or steady force, extreme or awkward finger/arm/hand position, repetitive forceful motions, or excessive gripping, pinching, or pressing with the hands and fingers.
6. Purge monitoring well and collect groundwater sample	Workers could come into contact with contaminants	Follow sampling procedures described in the Sampling and Analysis Plan. Wear Personal Protective Equipment as described in the Site-Specific Safety and Health Plan.
7. Decontaminate all reusable materials and equipment.	Worker could come into contact with contaminants.	Decontaminate any potentially contaminated equipment as described in the Sampling and Analysis Plan. Wear designated personal protective equipment as specified in the Site-Specific Safety and Health Plan. Handle any waste materials as described in the Investigation-Derived Waste Management Plan.

Section 2

Equipment to be Used	Inspection Requirements	Training Requirements
Sampling equipment, generator	See Principal Step 4.	Verification of subcontractor competency and training will be performed prior to field activities.

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Contract N68711-05-C-6406

Appendix C:

Investigation-Derived Waste Management Plan for Contamination Delineation at Remedial Unit C5

**Hunters Point Shipyard
San Francisco, California**

**November 2005
Revision 0**

Prepared for:



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Acronyms and Abbreviations

CE2	CE2 Corporation
DOT	Department of Transportation
HPS	Hunters Point Shipyard
IDW	Investigation-Derived Waste
Kleinfelder	Kleinfelder, Inc.
Navy	U.S. Department of the Navy
PPE	Personal Protective Equipment
RCRA	Resource Conservation and Recovery Act
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager

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1.0 Introduction

The purpose of this Investigation-Derived Waste (IDW) Management Plan is to provide guidelines for the containment, handling, and disposal of waste generated during contaminant delineation activities at Remedial Unit (RU) C5 performed under Navy Contract No. N68711-05-C-6406, at the Hunters Point Shipyard (HPS) in San Francisco, California.

This IDW Management Plan follows the U.S. Department of the Navy (Navy) guidance and regulations for the management and disposal of IDW, as specified in Resource Conservation and Recovery Act (RCRA) Title 40, Code of Federal Regulations, Parts 260-270 and Part 273.

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2.0 Roles and Responsibilities

All field personnel have a responsibility to manage IDW as described in the following sections.

2.1 Project Managers

CE2 Corporation (CE2) is the prime contractor to the Navy under Contract No. N68711-05-C-6406, with Kleinfelder, Inc. (Kleinfelder) providing subcontracted services. The CE2 Project Manager is Robert Ferry at (925) 872-7264. The Kleinfelder Project QC Manager is Gary Goodemote at (510) 628-9000. The IDW responsibilities of CE2 include placing waste in appropriate containers, labeling the containers, moving the containers to the waste storage area, monitoring cleanliness of the IDW storage area, and maintaining a container inventory log. The wastewater will be combined, managed, and disposed of according to the IDW Management Plan for these activities (Kleinfelder, 2004). CE2 will collect samples to profile any solid waste and coordinate with the appropriate Navy Representative and the waste disposal subcontractor for identifying the proper disposal and the timely removal of solid IDW from the HPS.

2.2 Waste Disposal Subcontractor

CE2 will utilize the services of a waste disposal subcontractor. The responsibilities of the waste disposal subcontractor include identifying the appropriate disposal for solid waste by evaluating the waste analytical profiles, handling, Department of Transportation (DOT) labeling, manifesting, and transportation of solid IDW to the appropriate offsite disposal facility.

2.3 Navy Representatives

The Remedial Project Manager (RPM) for this project is Ryan Ahlersmeyer at (619) 532-0960. The RPM will provide written approval of IDW disposal options.

The Resident Officer In-Charge of Construction (ROICC) San Francisco Bay Area is Peter Stroganoff at (510) 749-5941. The responsibilities of the ROICC include oversight of IDW operations and approving IDW shipments by reviewing and signing the waste manifests.

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3.0 Waste Generation

The contaminant delineation project at RU-C5 consists of the following field activities:

1. Passive soil gas measurements,
2. Soil coring,
3. Hydropunch[®] groundwater sampling,
4. Groundwater samples collected from existing groundwater monitoring wells,
5. IDW management, and
6. IDW transportation and disposal.

The types of IDW generated may include:

1. Soil cuttings from passive soil gas sampler installation,
2. Soil cuttings from hand auger holes advanced to confirm utility clearance,
3. Soil cores,
4. Wastewater from equipment decontamination,
5. Purge water from Hydropunch[®] and monitoring well sampling,
6. Used personal protective equipment (PPE), and
7. Inert or nonhazardous solid waste (refuse and/or concrete/asphalt cores).

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4.0 Waste Handling and Storage

Wastes generated during the RU-C5 contamination delineation will be assigned to one of three categories: (1) solid waste, (2) wastewater, or (3) used PPE and general refuse. These wastes will be handled as described in the following sections.

4.1 Solid Waste

Solid waste generated from passive soil gas sample installation, hand auger borings to confirm utility clearance, and soil coring will be placed into new DOT-approved 55-gallon drums and transported to a secured area adjacent to the Kleinfelder field office. The drums will be stored within a secondary containment structure. CE2 will collect IDW samples for analysis and waste profiling. The IDW analyses will be determined by the waste disposal subcontractor and disposal facility requirements. After the IDW analytical results are reviewed, disposal options will be identified and approved by the Navy RPM, and the solid IDW will be disposed of in an appropriate manner.

4.2 Wastewater

Wastewater will be generated from groundwater sampling purge water and equipment decontamination wash water. The wastewater will be collected in new 55-gallon DOT-approved drums during the field activities. At the end of each day, the drums will be emptied using an electric pump into a 4,000-gallon Baker tank located at the Kleinfelder field office. The wastewater will be combined with that generated through the Basewide Groundwater Monitoring Program, and managed according to the IDW Management Plan for those activities (Kleinfelder, 2004).

4.3 Personal Protective Equipment and General Refuse

Used PPE and inert or nonhazardous solid waste (refuse) generated during field activities will be disposed of as described in this section. Regular trash and nonhazardous construction debris will be segregated to the extent possible. Non-contaminated PPE will be placed in waste bins. Contaminated PPE and waste sampling equipment will be separated and placed in covered 55-gallon DOT-approved drums.

4.4 Container Labeling and Inventory

Each container will be clearly marked and labeled to indicate the waste source. The label color will be black and white (black lettering on white background) and weather resistant. The labels will not be used for shipping or disposal purposes. Before disposal or shipment offsite, containers will be labeled with the appropriate DOT identification and classification information by the waste disposal subcontractor. Information included on the label will include, at a minimum:

1. Contract number,
2. Project location,
3. Installation point of contact,
4. Site-specific location,

5. Owner,
6. Project Manager,
7. Navy RPM,
8. Container number,
9. Contents, and
10. Date(s) container filled.

IDW container information will be recorded on a Container Inventory Log maintained in the field office. Information contained in the Log will contain, at a minimum:

1. Project name,
2. Start and end date of waste generation activities,
3. Container identification number,
4. Container contents,
5. Date(s) container filled, and
6. Comments.

CE2 will inspect and document the condition of the IDW storage area and containers weekly.

5.0 Waste Characterization and Disposal

CE2 will collect characterization samples any solid waste for analysis and profiling. Solid IDW will be disposed of offsite within 90 days of collection. The 90-day requirement will begin on the first day of material placement in the container. The waste disposal subcontractor will provide services including, but not limited to, final DOT labeling, manifesting, and transportation of solid IDW. The Navy will select the methods and location of IDW disposal and sign the manifests.

The wastewater will be combined, managed, and disposed of according to the IDW Management Plan for the Basewide Groundwater Monitoring Program (Kleinfelder, 2004).

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6.0 Investigation-Derived Waste Management Process

To remove any contaminated IDW from HPS within 90 days of generation, IDW will be managed as follows:

Prior to Day 1 of waste generation activities:

1. Consult with a selected waste disposal subcontractor, and
2. Complete contracts for waste disposal.

Day 1 through Day 30 of waste generation activities:

1. Collect, containerize, and label solid IDW,
2. Collect, containerize, and transport aqueous IDW to the Baker Tank used by the Basewide Groundwater Monitoring Program,
3. Record IDW container information on the Container Inventory Log,
4. Obtain characterization samples of solid IDW, and
5. Submit the samples to a state-certified laboratory to assess solid IDW characteristics.

Day 30 through Day 48 of waste generation activities:

1. Develop a summary of solid IDW characteristics and coordinate the manifest generation and transportation of solid IDW with the waste disposal subcontractor.

Prior to Day 55 of field activities:

1. Obtain notification from the waste disposal subcontractor regarding the solid IDW classification and recommended disposal facility (based on solid IDW profiles), and
2. Notify the Navy Representative of the solid IDW classification and seek technical direction for solid IDW disposal.

Prior to Day 75 of waste generation activities:

1. Obtain technical direction for solid IDW disposal from the Navy Representative.

Prior to Day 80 of waste generation activities:

1. Coordinate the removal of the solid IDW before 90 days, and

2. Obtain the signature of the Navy Representative on the waste manifest authorizing transport of the solid IDW to a disposal facility.

Prior to Day 90 of waste generation activities:

1. Remove the solid IDW from the temporary storage area at HPS,
2. Obtain signed copy of the solid waste manifests from the waste disposal subcontractor for retention, and
3. Notify the Navy Representative when all solid IDW has been removed for disposal.

Both the Navy and CE2 have the responsibility to conduct a final inspection of the IDW management area to determine that all IDW has been properly removed.

7.0 References

Kleinfelder, 2004. "Draft Investigation-Derived Waste Management Plan, Basewide Groundwater Monitoring Program, HPS, San Francisco, California." April 5.

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Contract N68711-05-C-6406

Appendix D:

Responses to Regulatory Comments on the Draft Work Plan for Contamination Delineation at Remedial Unit C5

**Hunters Point Shipyard
San Francisco, California**

**November 2005
Revision 0**

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**Responses to Regulatory Comments on the
Draft Work Plan for Contamination Delineation at Remedial Unit RU-C5,
Hunters Point Shipyard, San Francisco, California**

This Appendix presents the U.S. Department of the Navy (Navy) responses to comments from the regulatory agencies on the draft “Work Plan for Contamination Delineation at Remedial Unit C-5, Hunters Point Shipyard, San Francisco, California,” issued on July 12, 2005. The U.S. Environmental Protection Agency (EPA), Region IX, the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB), and the California Environmental Protection Agency Department of Toxic Substances Control (DTSC) submitted comments.

Please note that there have been two significant changes to the scope of activities since the draft Work Plan was submitted:

1. Active soil gas sampling is no longer included in the scope of work. The principal value of collecting active soil gas samples is to evaluate vapor intrusion into existing or future buildings in support of a human health risk assessment. The two buildings at RU-C5 (123 and 134) are currently unoccupied, and it is unclear if they would house full-time occupants in the future or be demolished. It is not known if any new buildings would be constructed in the RU-C5 area or where they might be located. Active soil gas samples may be collected in the future if land and building use issues arise. References to active soil gas sampling in the Final Work Plan have been deleted. The ten active soil gas samples included in the Draft Work Plan have been replaced by ten additional Hydropunch[®] groundwater samples.
2. Passive soil gas sampling was conducted in August and September of 2005. Isoconcentration maps for selected analytes have been included in the Final Work Plan. Since this field work is complete, detailed information regarding sampling methodology and analyses have been deleted from the Final Work Plan but will be provided in the Technical Memorandum for this project along with the analytical data.

Please note that due to these changes to the scope of work, some section, table, and figure numbers have changed. References included in the comment responses refer to the Final Work Plan, rather than the Draft.

EPA Comments

EPA GENERAL COMMENTS

1. One of the objectives of the proposed investigation is to “Delineate the horizontal extent of VOCs in Parcel B adjacent to RU-C5 if the investigation indicates that contaminants from this area have migrated across the boundary into Parcel B” (Draft Work Plan page 1-1, and Draft Sampling and Analysis Plan [SAP] page 1-5) in two phases to “better define VOC contamination along and on either side of the Parcel Boundary,” but the figure provided in the Work Plan does not support the objective stated in the text. Figure A-5 shows the proposed Phase A soil gas sample locations situated either along, or on both sides of, the boundary separating Parcels B and C, but most of the proposed Phase B soil gas sample locations (with the exception of the locations to the north of Building 134) are situated on the Parcel C side of the boundary. Since the investigation objective is to delineate volatile organic compounds (VOCs) that have migrated “across the boundary into Parcel B” it appears that more of the Phase B locations should be installed on the “B” side of the parcel boundary. Please move most of the Phase B sample locations to the Parcel B property, or explain why the samples should be collected on the C side of the parcel boundary.

Response: The majority of the Phase B passive soil gas sampling locations were collected in Parcel B, as shown on Figures A-7 through A-11.

2. The descriptions of the stratigraphy and hydrostratigraphy are too general to be useful for delineation of dissolved-phase contamination and dense non-aqueous phase liquids (DNAPL) and there is no site conceptual model (SCM). In order to evaluate the potential for the presence and migration of DNAPL, it is important to understand the stratigraphy of RU-C5 and to develop a SCM that incorporates the stratigraphy, previous analytical results, previous detections of DNAPL, and DNAPL behavior. The stratigraphy at RU-C5 is very complex because the lithology of the Artificial Fill and Undifferentiated Upper Sand varies over short distances. For example, it appears that there is a gap in the less permeable Bay Mud beneath the former dip tanks that likely allowed DNAPL to migrate downward to the bedrock surface. Since the Bay Mud is present across most of the rest of IR-25, DNAPL may be present beneath this unit if the DNAPL migrated laterally along the bedrock interface and it is unlikely that shallow soil gas measurements will detect dissolved phase contaminants or DNAPL that are present beneath the Bay Mud. This SCM should include cross-sections like those developed for the Final Parcel C Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation, updated with the information acquired during the anaerobic-aerobic treatability study. At a minimum, two cross-sections should be provided in the Work Plan; these cross-sections should be updated to show the removal of the sump and dip tanks as well as the underlying soils and to include monitoring wells installed for this treatability study. Please provide a detailed SCM that incorporates the lithologic changes previously observed at RU-C5 and also provide two updated cross-sections that depict the current conditions at this site. Then, please use the SCM to revise the data quality objectives

EPA Comments (continued)

(DQOs) to ensure that the sampling design and data collected will accomplish the project objectives.

Response: Site conceptual models for: (1) hydrogeology, and (2) contamination have been included in the Work Plan (Sections 2.3.6 and 2.3.8, respectively) and SAP (Sections 1.1.5.5 and 1.1.5.7, respectively), along with two updated cross-sections (Figures A-3 and A-4). The DQOs in the SAP (Section 1.3.1) have been revised accordingly.

3. In the sections describing the groundwater flow at the facility, the Draft Work Plan (Section 2.3.4) and SAP (Section 1.1.5.4) indicates that the general groundwater flow direction is to the east-southeast, with local components to the northeast and southeast, including a groundwater divide and a groundwater trough, but Figure A-2 does not include sufficient information to support these interpretations. To support these interpretations and the SCM, it is recommended that potentiometric maps for the upper (A1) and lower (A2) aquifers be provided. This would also provide the reader and field team with an understanding of the groundwater flow directions throughout the RU-C5 area. Please provide potentiometric maps for the upper and lower A aquifers.

Response: A potentiometric surface map for the A aquifer (combined upper and lower) has been provided as Figure A-5.

4. In the sections describing the nature and extent of contamination in the RU-C5 area, the Draft Work Plan (Section 2.3.5) and Draft SAP (Section 1.1.5.5) refer to Figure A-2, but the extent of contamination shown on this figure is simply denoted by a stippled pattern over two discreet areas and it is not possible to determine the basis for the interpreted extent of contamination. For example, in the area north of Building 134, the figure indicates that the contaminant plume has crossed the boundary into Parcel B, however, there are no data points to substantiate this interpretation with the exception of monitoring well IR25MW38B (where groundwater contaminants were presumably detected) and monitoring wells IR25MW61A1 and IR25MW61A2 (where groundwater contaminants were presumably not detected). This type of graphical representation does not provide the reader with a definitive sense of the spatial distribution or concentrations of the constituents of concern (COCs) in the soils or aquifers in these areas. To address these concerns, isoconcentration maps of selected COCs in groundwater at IR-25 and IR-06 areas or tables that include historic and recent groundwater VOC data for all of the wells in RU-C5 should be provided. Please revise the Work Plan to include either isoconcentration maps of selected COCs in groundwater or to include tables that include all historic and recent groundwater VOC data for all of the wells in RU-C5.

Response: A map showing the distribution of selected VOCs in groundwater has been provided as Figure A-6.

EPA Comments (continued)

EPA SPECIFIC COMMENTS

1. Section 1.1, Objectives and Scope of Work Page 1-2; Section 4.3, Sampling Design, Page 4-2; and Appendix A, Section 2.1.1, Investigation Design, Page 2-1:

The first numbered item states that the intent of the Phase A passive soil gas sampling activity is to “identify areas where VOCs may have migrated across the boundary,” but the Phase A sampling results will primarily provide information on VOCs which have migrated across the boundary within the upper two feet of soil because the EMFLUX[®] samplers will be placed at a depth of 2 feet or less (SAP Section 2.1.4, page 2-4). While it is acknowledged that some contribution of the soil gas sorbed by the EMFLUX[®] samplers could be derived from vapors migrating upward from contaminated soils at lower depths, it is likely that the majority of the mass sorbed by the samplers will be derived from contamination within the upper two feet of the soil column. Please revise the text to discuss this issue.

Response: The passive soil gas sampling approach was designed to identify compounds that are present in the soil or groundwater beneath the location from which the sample is collected, and not just from the depth at which the sample was collected. Therefore, VOCs that have migrated beneath the sample locations at depths greater than two feet will also be identified. As demonstrated in the evaluation of the EMFLUX System at the EPA’s soil-gas test site, the EMFLUX System was able to identify, with a 0.91 correlation coefficient, contamination in the groundwater at a 30-foot depth when collecting samples at the near surface. Where the ground surface is paved, as in the majority of the RU-C5 area, and the contaminants have been present in the subsurface for several years, flux to the atmosphere is negligible and contaminant concentrations in soil gas are likely in equilibrium throughout the vadose zone soil column.

The passive soil gas sampling is complete, and summaries have been included in the Work Plan (Section 2.3.7.2) and SAP (Section 1.1.5.6). Details of the survey will be provided in the Technical Memorandum.

2. Section 1.1, Objectives and Scope of Work Page 1-2; Section 4.3, Sampling Design, Page 4-2; and Appendix A, Section 2.1.1, Investigation Design, Page 2-1:

The third numbered item listed at the top of page 1-2 states that after the completion of the Phase A and Phase B soil gas sampling events, all of the data will be reviewed to “evaluate the depths of permeable sediments in the vadose and saturated zones,” but it is unclear how this will be done. In addition, the approach does not take the presence of a discontinuous low permeability layer like the Bay Mud into account. The depth, thickness and continuity of low permeability layers should also be considered when sampling locations are selected. Please revise the text to clarify how the evaluation of permeability will be accomplished (e.g., visually, laboratory analysis of permeability,

EPA Comments (continued)

etc.) and also revise the text to indicate that the depth, thickness and continuity of low permeability layers will also be considered.

Response: Soil permeability will be evaluated visually. The SAP (Section 2.1.5.2) has been modified as suggested.

3. **Section 2.1, HPS Facility Background, Page 2-1 and Appendix A, Section 1.1.3, HPS Facility Background, Page 1-1:**

Since the transfer of Parcel A, Hunters Point Shipyard (HPS) is no longer 936 acres with 443 acres of land. In addition, there are still six parcels, since Parcel E has been split into E and E2. Please use the current size of HPS and change the text to indicate that there are six parcels.

Response: The Work Plan (Section 2.1) and SAP (Section 1.1.3) have been modified as suggested.

4. **Section 2.3.5, Nature and Extent of Contamination, Pages 2-3 and 2-4:**

The text does not describe the anaerobic-aerobic treatability study conducted at RU-C5 or the current range of contaminant concentrations at IR-25 and IR-06. Please include a brief description of the anaerobic-aerobic treatability study and specify the range of concentrations for each contaminant at IR-25 and IR-06.

Response: The Work Plan (Section 2.3.2.2) and SAP (Section 1.1.6) have been modified to include a summary of the anaerobic-aerobic treatability study. A map showing the distribution of selected VOCs in groundwater has been provided as Figure A-6.

5. **Section 3.2.4, Stormwater, Page 3-1:**

The text states that stormwater Best Management Practices (BMPs) will be established to prevent runoff from the site from impacting San Francisco Bay, but the BMPs are not specified and the Work Plan does not include any detailed description of the BMPs or indicate where this information can be found. Please either include details about the specific BMPs that will be implemented or provide a reference to indicate where this information can be found.

Response: The BMP for mitigating potentially contaminated runoff is by maintaining good housekeeping practices (i.e., ensuring no contaminated soil or groundwater are left on the pavement that could be transported to San Francisco Bay by runoff). The Work Plan (Section 3.2.4) has been modified as suggested.

6. **Appendix A, Section 1.1.5.1, Site Use, Page 1-2:**

This section of the SAP indicates that a soil vapor extraction (SVE) system in Building

EPA Comments (continued)

134 was operated for approximately 5 months in 2001, but details of the system were not provided in the text. For completeness, the SAP should include a brief description of the SVE system including its general design, period of operation, and degree of success (e.g., number of pounds of VOCs removed, soil gas concentrations in the sampling stream at system shut-down, rebound, etc.). In addition, brief descriptions of the other remedial actions implemented in this area (i.e., excavations and bioremediation study) should be included in the text. Please revise the SAP to include this information.

Response: This background information has been included in the Work Plan (Section 2.3.2.1) and SAP (Section 1.1.6).

7. Appendix A, Section 1.1.5.5.1, IR-25 Area, Page 1-3:

This paragraph presents a list of the “Other VOCs” detected in the IR-25 area, but fails to list the primary COCs (e.g., PCE, TCE, cis-1,2-DCE, 1,2-DCA, ethane, vinyl chloride, 1,2-dichlorobenzene, and 1,4-dichlorobenzene), which are listed in Section 2.3.5.1 of the Draft Work Plan. Please revise the text to include the primary COCs

Response: The Work Plan (Section 2.3.7.1) and SAP (Section 1.1.5.6) have been modified as suggested.

8. Appendix A, Section 1.3.1, Data Quality Objectives, Step 3. Inputs, Page 1-6:

The only listed inputs are “VOC concentration data from samples of soil gas and groundwater,” but detailed lithologic information will be needed to determine whether DNAPL is present. Detailed lithologic information would include the lithology, as well as the strike and dip of low permeability layers and the bedrock surface. If DNAPL is present beneath low permeability layers, VOC concentrations indicative of the presence of DNAPL may not be detected. Therefore, it is critical to have detailed and accurate lithologic information. Please include both existing lithologic information and lithologic information that will be collected as part of this study in “Step 3. Inputs.”

Response: The DQOs in the SAP (Section 1.3.1) have been modified as suggested.

9a. Appendix A, Section 1.3.1, Data Quality Objectives, Step 5. Decision Rules, Page 1-7:

The two proposed decision rules are not sufficient for this study because they do not take the lithology of the site into account and do not explain how the data collected during each phase will be used to optimize sampling locations in subsequent phases. Since the presence of a low permeability layer could mask the presence of DNAPL present beneath the layer, shallow soil gas samples may not detect DNAPL that is present. This would be a decision error that could be avoided by incorporating a decision rule that involves lithology and the SCM. In addition, it is unclear why the Phase II locations on Figure A-

EPA Comments (continued)

5 include some infill locations between Phase I locations and some locations to expand the area of investigation. The decision rules should be written with if ... then statements to specify how the sampling design will be optimized for subsequent phases. Please include one or more decision rules that incorporates lithology and at least one additional rule to explain how the sampling design should be optimized in subsequent phases, by specifying the rules for infill and expansion locations.

Response: The DQOs in the SAP (Section 1.3.1) have been modified as suggested. Please note that the portions of the comment regarding passive soil gas sample locations are no longer applicable because this work has been completed.

9b. **Appendix A, Field Documentation, Pages 1-10 and 1-11 and Section 2.1.5.3, Soil Coring, Page 2-5**

The description of field documentation does not include lithologic logging of the soil cores and the requirements for logging are not specified in the text. Please include a detailed list of specific requirements for lithologic logging or include a copy of the field form that will be used for lithologic logging as an attachment to the SAP.

Response: The SAP (Section 2.1.5.2) has been modified as suggested.

10. **Appendix A, Section 2.1.1.2, Soil Coring Page 2-2:**

The last sentence in this section states that the actual locations of the soil cores will be “based on the results of the passive soil gas data.” It is not clear from the text exactly what this analysis will involve. For example, it is unclear if the soil core locations will be selected from the five areas with the highest VOC concentrations, from areas with any soil gas detections, or using some other criteria. Please revise the SAP to provide the criteria by which the five soil core locations will be selected.

Response: The SAP (Section 2.1.1.1) has been modified as suggested.

11. **Appendix A, Section 2.1.1.5, Monitoring Well Sampling, Page 2-3:**

It is unclear why some of the alternative wells have been chosen because some of them are not near the Parcel B/C boundary. For example, IR25MW50A is not located near the dip tanks and is more than 160 feet from the western boundary of Parcel C. Similarly, IR25MW39B and IR06MW41A are not near the B/C boundary. Further, halogenated VOCs have not been detected in these three monitoring wells. VOCs were only detected during a single sampling round in January 1998 in IR06MW44A, and were not detected at concentrations indicative of DNAPL. VOCs were only detected occasionally in IR25MW42B, and were not detected at concentrations indicative of DNAPL. This suggests that these alternate wells should not be included in this study. Similarly, VOCs have not been detected in the proposed primary wells or were only detected at low

EPA Comments (continued)

concentrations (e.g., IR25MW38B and IR25MW39A). The screened intervals of all proposed primary and alternative wells should be evaluated and compared to the lithology of IR06/25 to determine whether the wells are suitable for the goals of this study. In addition, historical analytical results in proposed wells should be used to evaluate whether the SCM developed for this study predicts the analytical results before a well is chosen for inclusion in this study. Please develop a SCM, evaluate the screened intervals of monitoring wells to determine if the screened interval is suitable for the goals of this study, and evaluate historical analytical results and whether the SCM predicts those results before selecting monitoring wells to be sampled in this study.

Response: Site conceptual models for: (1) hydrogeology, and (2) contamination have been included in the Work Plan (Sections 2.3.6 and 2.3.8, respectively) and SAP (Sections 1.1.5.5 and 1.1.5.7, respectively).

There are a limited number of monitoring wells in the area that are not sampled as part of the Basewide Groundwater Monitoring Program. Sampling two of the listed monitoring wells (IR25MW38B and IR25MW39A) was requested by the regulatory agencies in comments on the SAP for the Basewide Groundwater Monitoring Program. Wells IR06MW46A and IR25MW37B are completed in the A-aquifer along the boundary between Parcels B and C. Although well IR06MW34A is not located near the boundary between Parcels B and C, obtaining VOC concentration data from this well would support the overall RU-C5 investigation. The selection criteria has been clarified in the SAP (Section 2.1.1.3).

12. **Appendix A, Section 2.1.5.5, Groundwater Sampling using Hydropunch[®], Page 2-6, and Section 2.1.5.6, Groundwater Sampling from Existing Monitoring Wells, Page 2-7:**

There is no description of the requirements for filling VOC vials in Section 2.1.5.5 and the procedure in item 14 of Section 2.1.5.6 does not specify what will be done if bubbles are detected in a VOC vial after it is closed. It is recommended that VOC vials be discarded and new vials be filled if bubbles are detected in VOC vials after they are closed. However, if there is evidence of a separate phase DNAPL in the VOC vial, it should be sent for analysis even if one or more bubbles is present in the vial. Please specify procedures to be followed if one or more bubbles is observed in a VOC vial after it has been closed.

Response: The SAP (Sections 2.1.5.3 and 2.1.5.4, item 14) has been modified as suggested.

DTSC Comments

Comments

1. The WP presents a significant field effort which is responsive to previous comments from DTSC.
2. **Indoor air pathway**
 - a) Occupants of buildings are the primary concern in evaluating the indoor air pathway over and adjacent to VOC plumes. Sampling of the subsurface under occupied buildings is recommended for all buildings located above or adjacent to volatile organic compound (VOC) plumes. However, the sampling design focuses on the boundary of Parcels B/C: no sampling is proposed in or under buildings. Please consider subslab sampling (passive and active soil gas) for all buildings which may overlie or impinge on the VOC plume area. Subslab sampling should be consistent with USEPA guidance on subslab sampling.

Response: Active soil gas sampling is no longer included in the scope of work.

- b) Engineering controls (ECs), institutional controls (ICs), soil gas monitoring, and/or indoor air monitoring may be required for occupied buildings located above or adjacent to VOC plumes. With respect to indoor air risks, areas without investigation cannot be assumed to be clean (e.g., areas under buildings). Additional work may be required.

Response: Comment noted.

3. Sampling design/schedule

- a) The WP says (page 1-1): "Information obtained from each step of the investigation will be used to design subsequent sampling activities." This action is appropriate. However, there is a concern that the field work which is actually conducted may be substantially different from the program which is presented in the WP because, in the WP, no opportunity is provided for regulatory input with respect to adjusting final locations for active soil gas sampling, soil coring, Hydropunch[®] sampling, and well selection. It is recommended that preliminary results for each phase of work be presented to regulators so that regulatory input can be provided with respect to succeeding phases of work.

Response: The proposed locations of the Phase A passive soil gas samples were reviewed by the regulatory agencies prior to conducting this field work. The Phase B passive soil gas locations were selected to provide additional detail and to expand the investigation laterally. The proposed Hydropunch[®] and soil core locations were provided to the regulatory agencies prior to the finalization of the Work Plan.

- b) The field work has already begun for this WP. That is, Phase A of passive soil gas sampling (scheduled for July 21 through August 11, 2005) is already completed and

DTSC Comments (continued)

Phase B is scheduled for August 11 through September 1, 2005 (Figure A-3). Therefore, regulatory comments on the passive soil gas program will not be reviewed by the Navy and the Navy's consultants until Phase A is completed and, moreover, comments may not be reviewed in time to influence Phase B. Please discuss how agency comments will be addressed.

Response: Isoconcentration maps for selected analytes in the passive soil gas samples have been included as Figures A-7 through A-11. The proposed Hydropunch[®] and soil core locations were provided to the regulatory agencies prior to the finalization of this Work Plan.

4. Analytes (Section 2.31 and Tables A-4, -5, and -6)

The focus of the investigation is on the indoor air pathway. Therefore, VOCs are the analytes of concern. Non-VOCs (e.g., metals) are not included as analytes.

Response: It should be noted that the focus, and subsequently the objectives, of this investigation is not on the indoor air pathway. Risk due to the inhalation of indoor air is being evaluated in the Parcel C Feasibility Study.

- a) Ideally, compounds detected in one media will be analyzed for in other media. However, lists of analytes for various media do not agree (Tables A-4, -5, and -6). For example, Method 8260B is proposed for both passive soil gas and groundwater samples: however, different lists of analytes are presented for each media. Please revise all analyte lists to include all compounds previously detected in all media. Additionally, please confirm that all method analytes will be analyzed for.

Response: Due to the removal of passive and active soil gas sampling and analysis from the Work Plan, the analyte lists for these activities have been deleted. Table A-4 (formerly Table A-6) has been revised to include all EPA Method 8260B compounds currently analyzed for in the Basewide Groundwater Monitoring Program, plus naphthalene.

- b) Please include (for all media) all VOCs noted in SAP Section 1.1.5.5.1.

Response: Table A-4 has been revised to include all EPA Method 8260B compounds currently analyzed for in the Basewide Groundwater Monitoring Program, plus naphthalene.

- c) Naphthalene has been measured in groundwater samples in the IR06/25 area at concentrations that may be a concern for the indoor air pathway. Naphthalene is included as an analyte for passive soil gas but not for groundwater or active soil gas. Please include naphthalene as an analyte for groundwater and active soil gas.

DTSC Comments (continued)

Response: Naphthalene has been included as an analyte for groundwater in Table A-4. Active soil gas sampling has been removed from the scope of work.

- d) Please ensure that all media will be analyzed for the 23 primary and 4 other target compounds cited in LA RWQCB's 1997 guidance for active soil gas investigations. Some compounds on the LA RWQCB's list are not included as analytes in the WP: for example, vinyl chloride is not included for passive soil gas samples. Please review the guidance which is located at:

http://www.swrcb.ca.gov/rwqcb4/html/programs/ust/03_0210_Interim%20Guidance%20for%20Active%20Soil%20Gas%20Investigations.pdf.

Response: Vinyl chloride was included in the analyte list for the passive soil gas samples. The portion of the comment regarding active soil gas is no longer applicable. The Work Plan has not been modified in response to this comment.

- e) Please report all quantifiable results. In addition, please include all tentatively identified compounds (TICs).

Response: The SAP (Section 2.3.1) has been modified to state that all quantifiable results will be reported. To be consistent with the protocols for the Basewide Groundwater Monitoring Program, TICs will not be reported.

- f) Sampling for total petroleum hydrocarbons (TPH) should be considered for all media, since IR06 was a petroleum tank farm (including waste oil).

Response: The objective of the investigation is to evaluate potential migration of VOCs into Parcel B from Parcel C. The groundwater analyses include the volatile constituents of petroleum fuels. The Work Plan has not been modified in response to this comment.

- g) Consider analyzing active soil gas samples for radon.

Response: The objective of the investigation is to evaluate potential migration of VOCs into Parcel B from Parcel C. The Work Plan has not been modified in response to this comment.

5. Soil Gas Sampling

Shallow passive soil gas sampling is proposed at 25 locations (Phase A) and 25 locations (Phase B) (Section 2.1.1.1). Active soil gas sampling is proposed at 10 locations (Section 2.1.1.3).

- a) Sampling density (both active and passive soil gas sampling) is lower near the south corner of Building 123, which is a location of particular concern between two plumes at

DTSC Comments (continued)

the Parcels B/C boundary. Please include additional passive and active soil gas sampling locations near the south corner of Building 123.

Response: Because the passive soil gas sampling is complete and active soil gas sampling has been removed from the scope of work, this comment is no longer applicable. The Work Plan has not been modified in response to this comment.

- b) Existing utilities, ground penetrations, and railroad ballast may serve as preferential pathways. Hence, it is necessary to evaluate such features with respect to proposed locations for soil gas sampling. Please include all utilities, ground penetrations, and railroad ballast on Figure A-4.

Response: Sampling locations have been evaluated with respect to the locations of underground utilities, and any observed effects from these features will be discussed in the Technical Memorandum. The Work Plan has not been modified in response to this comment.

Passive soil gas

- c) Product information at the EMFLUX® website indicates that collection of passive soil gas samples during optimum gravitational tides is a feature of the EMFLUX® methodology. So, presumably, passive soil gas samples are to be collected at optimum gravitational tides. Please identify optimum sampling windows in the WP.

Response: Review of the EMFLUX® website indicates that there are two to five 72 hour periods of optimum gravitational tides for sampling over a 30 day period. Considering the passive samplers were left in place for seven days during each Phase of the investigation, one optimum period was likely achieved. Furthermore, the purpose of the passive soil gas sampling is to determine relative, not absolute soil gas concentrations. Incidentally, the passive sampling was completed prior to the receipt of this comment.

- d) EMFLUX® adsorbent cartridges are suspended in a pipe that is driven a minimum of 12 inches into the ground (Section 2.1.5.1). To evaluate potential dilution of shallow passive soil gas sampling locations by ambient air, please sample at multiple depths greater than 12 inches at several locations, including sampling at depths used for active soil gas collection.

Response: Please see response to EPA Specific Comment 1. The intent of the passive soil gas sampling was only to collect screening-level data on the lateral extent of contamination. Please note that passive soil gas sampling strategy and methodology have been deleted from the Work Plan, since this work has been completed.

DTSC Comments (continued)

- e) For passive soil gas samples, no holding time are specified on Table A-3. Holding times for EPA Method 8260B apply: please revise Table A-3.

Response: There are no specific holding times established for passive soil gas samples. The 30-day holding time is consistent with NIOSH methods where the sampling media (i.e., the EMFLUX samplers) are adsorbents. Please note that passive soil gas sampling strategy and methodology have been deleted from the Work Plan, since this work has been completed.

- f) Since the WP should be a stand-alone document, citing the EMFLUX® website is not sufficient. Similarly, reference to protocols in a separate USEPA document is not sufficient (Section 2.1.5.1). Please provide sampling protocols (including protocols to protect samples from exposure to sunlight). Include a figure illustrating EMFLUX® passive soil gas sampling.

Response: Since the passive soil gas sampling is complete, this information will be provided in the Technical Memorandum. Summaries of the passive soil gas sampling have been included in the Work Plan (Section 2.3.7.2) and SAP (Section 1.1.5.6).

- g) No information is provided regarding locations and protocols for determining soil gas flux. Please discuss criteria for selection of flux measurement locations. Provide protocols for flux measurements (including protocols for protection against sunlight) and a figure showing the flux measurement setup.

Response: Soil gas flux measurements are not included in the scope of work.

Active soil gas

- h) To minimize the potential for ambient air diluting active soil gas samples, sample collection should be below the depth of diurnal/seasonal pulsing and below utility corridors. Proposed depths are 3 to 5 feet below the ground surface (fbgs). 3 fbgs is too shallow. 5 fbgs is recommended in DTSC's Advisory-Active Soil Gas Investigations: however, 5 fbgs may be too close to existing utilities at this site. Please re-evaluate proposed sampling depths.

Response: The comment is no longer applicable since active soil gas sampling has been removed from the scope of work.

- i) Please ensure that active soil gas samples are collected at optimum gravitational tides.

Response: The comment is no longer applicable since active soil gas sampling has been removed from the scope of work.

DTSC Comments (continued)

- j) Please ensure that active soil gas investigations are consistent with DTSC's Advisory-Active Soil Gas Investigations (AASGI), at:

<http://dtscm/LawsRegsPolicies/Policies/SiteCleanup/loader.cfm?url=/commonspot/security/getfile.cfm&pageid=4729>. For example, include: purging protocols, purge rates, sampling rates (100 to 200 ml/min is recommended), et cetera. Revise the WP as needed.

Response: The comment is no longer applicable since active soil gas sampling has been removed from the scope of work.

- k) Please include climatic conditions that preclude soil gas sampling. For example, DTSC recommends that soil gas sampling should not be conducted during or immediately after a significant rain event (e.g., ½ inch or greater) or onsite watering.

Response: The comment is no longer applicable since active soil gas sampling has been removed from the scope of work.

- l) The AASGI advises against air shipping of Summa® canisters. Are the active soil gas samples (and samples of other media) going to be transported to the laboratory by air? If air-shipping is to be used, describe protocols to minimize pressurization effects.

Response: The comment is no longer applicable since active soil gas sampling has been removed from the scope of work.

- m) DTSC's AASGI recommends a holding time of 72 hours for soil gas collected in Summa® canisters. Please change Table 3A to say 72 hours (not 30 days).

Response: The comment is no longer applicable since active soil gas sampling has been removed from the scope of work.

- n) Details are not provided regarding the construction of active soil gas monitoring points. Please provide a figure with construction details for active soil gas monitoring locations—including the sampling train.

Response: The comment is no longer applicable since active soil gas sampling has been removed from the scope of work.

6. Hydropunch®/DNAPL investigation

DTSC and other agencies have expressed concern that the VOC plume boundary is not fully delineated and that dense non-aqueous phase liquids (DNAPLs) may be migrating from Parcel C to Parcel B. Since DNAPL migrates along upper surfaces of impermeable units (e.g., bedrock), the shape and direction of migration of the shallow dissolved plume is not a valid indicator of DNAPL migration at depth. Therefore, investigation of potential migration of DNAPL should focus on impermeable or bedrock surfaces, which

DTSC Comments (continued)

are variable in the vicinity of IR06 and IR25. A Hydropunch® investigation (42 locations) has been proposed. However, at most locations (35 locations), only shallow sampling is proposed. Deeper sampling (7 locations) is proposed only in the immediate vicinity of one source area at IR25.

- a) Bedrock dips to the northwest near the Parcels B/C boundary west of IR06. In this area, the historical maximum for vinyl chloride (1000 ug/L) was measured at IR06MW59A1. However, there are no monitoring wells downgradient or downdip of IR06MW59A1, between the well and the Parcel C/B boundary near the south corner of Building 123. Shallow sampling is proposed but deeper sampling is not proposed in this area. Please include Hydropunch® sampling to bedrock at three locations between IR06MW59A1 and the Parcels B/C boundary.

Response: The suggested sampling locations have been included on Figure A-14. This figure was provided to the regulatory agencies prior to finalizing this Work Plan.

- b) Bedrock dips to the northeast on the Parcels B/C boundary between IR25 and Building 130. Please include sampling at various depths in this area.

Response: The suggested sampling locations have been included on Figure A-14. This figure was provided to the regulatory agencies prior to finalizing this Work Plan.

- c) Please explain the criteria to be used when selecting locations for Hydropunch® samples in the DNAPL investigation. Revise Section 2.1.1.4 accordingly.

Response: The SAP (Section 2.1.1.2) has been revised as suggested.

- d) Depths of Hydropunch® samples are not specified but will be “determined after reviewing the soil cores and logs from previous nearby borings”. Please include the criteria for selecting depths for sampling for both shallow and deeper samples. Also, it is recommended that agency input be solicited prior to selection of final sampling depths.

Response: The SAP (Section 2.1.1.2) has been revised as suggested.

- e) The text says that Hydropunch® groundwater samples will be collected using: “a bailer, bladder pump, Wattera®, or comparable sampling system”. Collection of a Hydropunch® sample does not require pumping, since groundwater flows into the tool which is then lifted to the surface: please explain why pumps are mentioned.

Response: The Hydropunch® system that will be used requires that the sample be collected using a polyethylene tube with a bottom check valve. The tubing is moved up and down gently to minimize volatilization, resulting in water flow from the end of the tube above the ground. The SAP (Section 2.1.5.3) has been modified accordingly.

DTSC Comments (continued)

- f) The WP should specify actual methods to be used in the field—not provide a list of options (as in the previous comment). Please specify the methods and protocols which will be used for groundwater sample collection and revise the WP accordingly.

Response: The descriptions of field methods described in the SAP have been modified as suggested.

- g) In order to prevent volatilization of the contaminants of concern, the sampling/pumping method proposed should minimize sampling disturbance, including pressure changes. Bailing is discouraged. If pumps are employed, DTSC recommends a sampling rate of 100 ml/min or less for VOC samples.

Response: The groundwater samples from existing monitoring wells will be collected using the same protocols as are used for the Basewide Groundwater Monitoring Program, which uses approved low-flow sampling procedures. The Work Plan has not been modified in response to this comment.

- h) Provide figures of the sampling train for both Hydropunch[®] (and monitoring well) sampling.

Response: The Hydropunch[®] groundwater samples will be collected by placing a polyethylene tube with a bottom check valve into a temporary well screen. The tubing will be gently moved up and down to minimize volatilization, resulting in water flow through the check valve through the tube to the ground surface. The sample bottles will be filled directly from the discharge tube.

For the monitoring well sampling, the water from the discharge line of the sampling pump is directed into a flow-through cell. When parameters have stabilized, the flow cell is removed and the VOA vials are filled directly from the discharge tube.

The Navy believes that no additional figures are needed to illustrate the sampling train. The Work Plan has not been modified in response to this comment.

7a. Monitoring well sampling

Sampling from 5 monitoring wells is proposed.

- a) Ideally, the depth for pump intake is selected for each well after review of well construction, historic ground water levels, and stratigraphy. Section 2.1.5.6 says: “For shallow monitoring wells, set tubing inlet at 10 feet above the bottom of the well. For deeper monitoring wells, set tubing inlet in middle of screened interval.” The proposed pump intake depth of “10 feet above the bottom” for shallow wells is not acceptable, since: the length of screened interval varies considerably at Hunters Point; some well screens are 10 feet long or less; and, significant silting/scouring has been observed. An

DTSC Comments (continued)

acceptable practical approach is to set pump intakes for shallow (i.e., water table) wells at half the saturated screened length. Please revise the WP accordingly.

Response: The SAP (Section 2.1.5.4, item 8) has been revised as suggested.

- b) Please coordinate groundwater sampling from wells with groundwater sampling of the BGMP, so that results will be comparable.

Response: The wells will be sampled during roughly the same time period as are nearby wells sampled for the BGMP.

- c) It would be useful to collect groundwater samples using passive diffusion bags (PDBs) during this multi-media effort. Current information on PDBs can be found at ITRC, USGS, and USEPA websites. For example, see Comparison of Diffusion and Pumped Sampling Methods to Monitor Volatile Organic Compounds in Ground Water, Massachusetts Military Reservation, Cape Cod, Massachusetts, July 1999-December 2002, by Stacey A. Archfield and Denis LeBlanc, USGS Toxic Substances Hydrology Program, Scientific Investigations Report 2005-5010.

Response: The sampling protocol as presented in the Work Plan is consistent with the Basewide Groundwater Monitoring Program. The use of PDBs will be evaluated in the future as part of the BGMP. The Work Plan has not been modified in response to this comment.

- d) It cannot be determined whether wells selected for groundwater sampling are optimum, since results of groundwater sampling from wells in the area are not presented and well construction information is not presented. To support the sampling rationale, please include spider maps with results of investigations, well construction details, and cross sections.

Response: Please see the Navy's response to EPA Specific Comment 11.

- e) Multiple problems with well condition and well sampling protocols have been observed at Hunters Point, as noted in recent comments regarding the base wide groundwater monitoring program (BGMP). To ensure that wells selected are suitable for sampling, please inspect all wells prior to sampling, assess water quality stabilization parameters, and provide well inspection logs/corrective action forms in the report.

Response: The wells will be inspected and evaluated prior to sampling. The results and any substitute wells sampled due poor well condition will be provided in the Technical Memorandum.

- f) Oxidation Reduction Potential (ORP) will be measured using an "Oakton Instrument" (Section 2.1.5.6). Oakton ORP probes are not all adequate for measuring the range of

DTSC Comments (continued)

ORP values expecting in groundwater (e.g., ORP testers are inadequate). Please specify the probe to be used and confirm that the operating range of the probe encompasses the range of ORP values expected in groundwater.

Response: The Oakton ORP Tester 10 probes that will be used have a range of -999mV to +1000mV. This range is sufficient for measuring ORP in the monitoring wells to be sampled. The SAP (Section 2.1.5.4, item 9) has been modified to reflect the use of these instruments.

- g) Please explain why 8 liters has been cited as the minimum purge volume.

Response: This is consistent with the BGMP SAP, which specifies a minimum purge volume of 8 liters. The Work Plan has not been modified in response to this comment.

- h) Excessive draw down is defined as “water level drops below pump inlet”. Please revise to define excessive drawdown with respect to the length of the water column in the well (e.g., .3 feet per 10 feet of water column).

Response: The SAP (Section 2.1.5.4, item 13) has been revised to be consistent with the current BGMP procedures that state: “Excessive drawdown is considered to be a drawdown greater than 25% of the original water column above the pump intake.”

7b. Soil Cores

Soil cores are used to evaluate air permeability and potential pathways/barriers for soil gas.

- a) Soil cores are proposed at 5 locations (A-5). Please collect soil cores at or directly adjacent to all active soil gas locations (unless such information already exists, for example, in nearby well logs).

Response: The comment is no longer applicable since active soil gas sampling has been removed from the scope of work.

- b) Ideally, soil samples are collected from screened intervals of active soil gas monitoring locations and from other intervals where physical data may be used in modeling (e.g., intervals where grain size will be used to estimate air permeability). However, no soil samples are proposed. Please include soil sampling. Provide criteria for selecting soil sampling locations. Specify chemical and physical analyses. Physical tests should include: density, organic carbon content (Walkee Black method), soil moisture, porosity, and grain size distribution. Effective permeability is also recommended.

Response: The comment is no longer applicable since active soil gas sampling has been removed from the scope of work.

DTSC Comments (continued)

8. ARARs (WP Section 3.0).

- a) California Well Standards, Bulletins 74-81 and 74-90 contain recommended minimum standards for the protection of groundwater quality, including requirements for construction, maintenance, and destruction of monitoring wells and for exploratory borings. Also, the California Water Code, Division 7 contains requirements for installation of monitoring wells, including drillers' requirements. Please include these ARARs.

Response: Section 3.2.6 has been added to the Work Plan as suggested, but please note that installation of monitoring wells is not within the scope of this investigation.

9. Methods

EPA Method T015 is proposed for VOC analysis of active soil gas samples: 8260B is proposed for passive soil gas and groundwater samples.

- a) To evaluate health effects with respect to human occupancy, it is necessary to delineate the extent of lower VOC concentrations. Preliminary remedial goals (PRGs) for some VOCs are low. However, proposed reporting limits (RLs) are greater than PRGs by orders of magnitude (Tables A-5 and A-6). For example, for trichloroethene (TCE), the USEPA PRG (ambient air, October 2004) is 0.017 ug/m³: but the proposed RL for TCE is 1 ug/m³ (for TO15). In order to achieve method detection limits (DLs) or reporting limits (RLs) which are lower than PRGs, TO15 or 8260 in selective ion mode (SIM) may be necessary. TO15 is appropriate for low concentrations (e.g., at plume margins) and 8260B is appropriate for higher concentrations (e.g., near source areas). Please re-evaluate the analytical program and consider using more sensitive SIM methods. If SIM methods are used, the selection of analytes (if restricted) should be discussed with agencies.

Response: The comment is no longer applicable since active soil gas sampling has been removed from the scope of work. It should be noted that the focus, and subsequently the objectives, of this investigation is not on the indoor air pathway. Risk due to the inhalation of indoor air is being evaluated in the Parcel C Feasibility Study.

- b) Alternatively, consider using more sensitive methods (SIM methods) as additional quality control at plume edges.

Response: The comment is no longer applicable since active soil gas sampling has been removed from the scope of work.

DTSC Comments (continued)

10. Data Quality Objectives (DQOs) and Risk Assessment

- a) Decision Rules (SAP page 7). Ideally, the extent of contamination should be determined to conservative risk-based criteria. In the WP, reporting limits (RLs) are proposed as indicators of extent of contamination and (it is implied) as indicators of potential risk. However, RLs are not risk-based numbers and so RLs cannot be used for this purpose: the usual process is to conduct a risk assessment (RA) based on investigation results. Moreover, the proposed RLs may not be sufficient with respect to risk assessment since, for multiple compounds, RLs are greater (by orders of magnitude) than PRGs, as discussed above. It is beyond the scope of the current investigation to determine when/if sufficient data has been collected for determining the extent of contamination or extent of potential risk.

- i) Please revise DQOs to say that the scope of the current investigation will be limited to the RLs proposed.

Response: The DQOs in Section 1.3.1 of the SAP have been modified as suggested. Please note that the objectives of this investigation are not to delineate this area with respect to risk.

- ii) Revise the WP to state that results of all investigations (current and historic) will be used to determine the extent of contamination, including results from the basewide groundwater monitoring program (BGMP), treatability studies (TSs) and remedial investigations (RIs).

Response: The objective of the investigation is to evaluate potential VOC migration across the boundary between Parcels B and C. The Work Plan has been modified to incorporate summaries of the previous treatability studies. Extent of contamination as it relates to remedial action will be discussed in the Parcel C Feasibility Study.

- iii) Review of the WP has been hampered by the fact that all results have not been collected and presented together. Please discuss how results from all investigations (including the WP investigations) will be evaluated and presented.

Response: Please see response to DTSC Comment 10 (a) (ii).

- b) The criterion proposed to determine whether dense non-aqueous phase liquids (DNAPLs) exist is 1% solubility. It has been noted by US EPA that: “this widely used rule of thumb has no fundamental theoretical basis” and that “...DNAPLs are present at many sites samples taken from groundwater in monitoring wells below one percent of the effective aqueous solubility...” (USEPA December 2003, The DNAPL Remediation Challenge: Is there a Case for Source Depletion?) Therefore, the 1% criterion is not sufficient to evaluate whether DNAPLs exist. Instead, all site data will be reviewed and

DTSC Comments (continued)

professional judgment applied to determine if additional work is required. Please revise DQOs accordingly.

Response: The DQOs in Section 1.3.1 of the SAP have been modified as suggested.

- c) RLs for passive soil gas are expressed in terms of mass--not in terms of concentration: on Table A-4, the proposed RL for all compounds is 25 nanograms. Moreover, passive soil gas results cannot be reliably correlated with or converted to soil gas concentrations, and hence, cannot be compared to risk levels (which are expressed as concentrations). Therefore, the significance of proposed RLs cannot be assessed with respect to extent of contamination (and implied risks). So, although passive soil gas results are useful for selecting locations for active soil gas samples, soil cores, and Hydropunch[®] samples, they cannot be used to determine the full extent of contamination (and the implied extent of elevated risk).

Response: Comment noted.

11. Figure A-4.

Please identify the companies for each person (i.e., CE2 or Kleinfelder).

Response: The organization chart (Figure A-13) has been modified as suggested.

12. Figure A-5.

Please revise to show the extent of all excavations and excavation depths. This information is needed in order to evaluate proposed sampling locations. For example, samples collected within backfilled excavations may be biased.

Response: The objective of the investigation is to evaluate potential VOC migration across the boundary between Parcels B and C. The Parcel C Feasibility Study will integrate data from this and other studies, including excavations. It is the Navy's belief that the excavations in this area will not adversely affect achievement of the objectives. In addition, adding this information will make the figure too complicated to be informative. No changes have been made in response to this comment.

13. Table A-5.

Please list compounds in alpha-numeric order.

Response: Because active soil gas sampling has been removed from the Work Plan, the referenced table has been deleted.

DTSC Comments (continued)

14. Appendix B: Draft Site-Specific Safety and Health Plan for Contamination Delineation at Remedial Unit C5

- a) Appendix B was not reviewed.
- b) Asbestos is an industrial waste at Hunters Point and is a common component of serpentinite rock and fill. Please include asbestos in Section 3.6.

Response: The scope of work includes only sampling using direct-push technology. These activities will not result bring bedrock or drill cuttings to the surface. No soil or bedrock excavation will be performed. Thus, exposure to asbestos is not considered a significant exposure risk. The Safety and Health Plan has not been modified.

RWQCB Comments

GENERAL COMMENT

General Comment No. 1:

We support the comments and recommendations provided by the U.S. EPA on the Draft Work Plan by letter dated August 11, 2005 and expect that their issues will be resolved through revision of the Draft Work Plan.

We are particularly interested in a site conceptual model for the Remedial Unit C5 area that integrates existing hydrogeologic data and depicts the relationships between the artificial fill, upper sand, and bedrock aquifers.

Response: Site conceptual models for: (1) hydrogeology, and (2) contamination have been included in the Work Plan (Sections 2.3.6 and 2.3.8, respectively) and SAP (Sections 1.1.5.5 and 1.1.5.7, respectively)

SPECIFIC COMMENT

Specific Comment No. 1, Figure A-2, Base Map for RU-C5:

Figure A-2 depicts groundwater flow directions that are based on February 2002 groundwater elevation data. We suspect that these elevation data predate site-wide repairs made to the leaky sanitary sewer, storm drain, and water line system. Historically, these leaky sewers and water lines created localized groundwater sinks and mounds which in turn resulted in questionable potentiometric interpretations.

Please use the most current groundwater elevation data set in developing the Remedial Unit C5 site conceptual model and in selecting the proposed soil gas and groundwater sampling locations.

Response: A potentiometric surface map has been added to the SAP as Figure A-5.